STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL | 97-024

INSTRUCTIONS

1. The preparing activity must complete blocks 1,2, 3, and 8. In block 1, both the document number and revision letter should be given.
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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD) **970603**

3. DOCUMENT TITLE
The National Imagery Transmission Format Standard (NITFS) Program Plan

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

This request provides an NTB control number for developing The National Imagery Transmission Format Standard (NITFS) Program Plan.

5. REASON FOR RECOMMENDATION

To provide a strategic plan for the NITFS migration from a suite of Department of Defense (DOD) military standards (MIL-STDs) to a suite of commercially accepted, international standards (IS) and profiles for implementation by users, systems, and vendors within the United States Imagery and Geospacial Information System (USIGS).

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National Imagery and Mapping Agency

The National Imagery Transmission Format Standard (NITFS) Program Plan

03 June 1997

Version 0.9

DRAFT

Comments to this version of the document should be forwarded to DannyRajan, NIMA SESR via e-mail (rajans@nima.mil or ntb@nima.mil) or voice: (301)227-5335 by COB 11 JULY 1997

TBD/TBR LISTING

Page Number	TBD/TBR Listing	Description
15	TBR01	Date when NITF 2.0 Pack capability is no longer mandated for NITF 2.1/BIIF ISP compliant systems
17	TBR02	Number of vendors that have been tested by the JITC for NITFS compliance
23	TBR03	ISMC/GSMC Document which defines “Bandwidth Compression Guidelines for the NITFS/BIIF” Document
24	TBR04	ISMC/GSMC Document which defines “Bandwidth Compression Guidelines for the NITFS/BIIF” Document
41	TBR05	ISMC/GSMC Document which defines “Certification, Test and Evaluation plan” for the NITFS/BIIF
45	TBR06	Inclusion of Paragraph on SDTS and relation to BIIF
47	TBR07	Date when USIGS ISP for 12087-5, BIIF, will be registered by ISO JTC1 and approved
48	TBR08	Date when USIGS profile for Lossy JPEG will be registered by AFNOR and approved by ISO JTC1
49	TBR09	Date when USIGS profile for Lossless JPEG will be registered by AFNOR and approved by ISO JTC1
78	TBR10	Date when USIGS ISP for ISO/IEC 8632-1, CGM, will be registered by ISO JTC1 and approved
04	TBR 11	Date when all NITFS/BIIF Systems must be BIIF ISP compliant under the guidelines of the NITFS Certification, Test and Evaluation Plan
43	TBR12	Inclusion of JPEG Multicomponent into the NITFS suite
44	TBR13	Inclusion of JPEG 2000 into the NITFS suite
04	TBR14	Mandated Convergence of RPF with NITFS/BIIF ISP
41	TBR15	Date when the JIEO Circ. 9008 is superceded by the ISMC/NIMA “Certification, Test and Evaluation plan”
15	TBR 16	Define relationship of JPEG Part 4 and TR10000 in terms of ISO profile registration, approval and terminology

CHANGE LOG

Date	Pages Affected	Mechanism

EFFECTIVITY LOG

Number	Effective	Description
E01	TBR11	All NITFS/BIIF Systems must be BIIF ISP compliant under the guidelines of the NITFS Certification, Test and Evaluation Plan
E02	TBR01	Requirement to support NITF 2.0 generation No longer mandated for compliance and certification
E03	TBR12	Inclusion of JPEG Multicomponent into the NITFS suite
E04	TBR13	Inclusion of JPEG 2000 into the NITFS suite
E05	TBR14	Mandated Convergence of RPF with NITFS/BIIF ISP

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PURPOSE

This document provides the strategic plan for the National Imagery Transmission Format Standard (NITFS) migration from a Department of Defense (DoD) Military Standard to a suite of commercially accepted, international standards and profiles for implementation by users, systems and vendors, within the United States Imagery and Geospacial System (USIGS). In addition, a summary of the technical changes made to the current Baseline of NITFS as well as transition schedules are discussed. The final section provides the detailed international standards profiles, based on internationally adopted standards, that are to be implemented by NITFS systems and applications. This document provides the authoritative, configured managed "in-progress" profiles for implementation of the NITFS suite of standards until such time that international profiles are registered with the appropriate registration authority.

SCOPE:

In addition to highlighting details of the transition of the NITFS to a suite of international standards and profiles, this document focuses on: specification differences between the current baseline NITFS (NITF 2.0) and nominated profiles of international standards; anticipated changes in community implementation agreements and compliance test criteria; and potential impacts to current DoD and Intelligence Community (IC) NITFS users . Specifically, focus is on the NITF 2.1 standard, which is being developed as an intermediate step to facilitate DoD use of international standards and documents in the acquisition of imagery systems, and its technically identical standard developed with the International Standards Organization (ISO).

APPLICABILITY:

This document is intended to be an informative aid to those parties planning to upgrade existing NITF2.0 implementations and/or those implementing NITF for the first time. Once published, the NITF2.1 standard, related standards and profiles, and certification test documents become the normative documentation for implementation. Upon the ratification of the USIGS profile of the International Standards Organization (ISO) Basic Imagery Interchange Format (BIIF), it shall become the normative documentation for implementation.

OBJECTIVES

The imagery and geospacial community of user currently implementing the NITFS suite of standards requires a configuration managed and systematically maintained program plan. The intent of this plan to provide users, program managers, developers, commercial vendors, and decision makers a reliable "road map" of the changes planned to the NITFS and it's successor profile, BIIF.

This document will provide a clear understanding of the changes planned to the standards, be they military standards or international standards profiles, as well as anticipated dates that the changes will be under configuration control. It is expected that revisions of this document will be provided to the USIGS community in intervals of six months to a year, so that users have enough time to asses impacts of proposed changes, as well as for program managers to budget the required changes into their program plans.

REFERENCES

MIL-STD-2500A	National Imagery Transmission Format (Version 2.0) for the National Imagery Transmission Format Standard, 12 October 1994
MIL-STD-2500B	National Imagery Transmission Format (Version 2.1) for the National Imagery Transmission Format Standard (DRAFT)
JIEO Circular 9008	NITFS Certification Test and Evaluation Program Plan,
MIL-STD-188-196	Bi-Level Image Compression for the National Imagery Transmission Format Standard
MIL-STD-188-198	Joint Photographic Experts Group (JPEG) Image Compression for the National Imagery Transmission Format Standard
MIL-STD-188-199	Vector Quantization Decompression for the National Imagery Transmission Format Standard
MIL-STD-2301	Computer Graphics Metafile (CGM) for the National Imagery Transmission Format Standard
MIL-STD-2045-44500	- Tactical Communications Protocol 2 (TACO2) for the National Imagery Transmission Format Standard
MIL-STD 188-197A	Adaptive Recursive Interpolated Differential Pulse code Modulation Image compression (ARIDPCM) for the National Imagery Transmission Format Standard
STANAG 4545 -Draft	NATO Secondary Imagery Format (Version 1.0); *Ratification Draft 1*

ISO/IEC 12087-5: DIS	Information technology - Basic Imagery Interchange Format
ISO/IEC Directives	Procedures for the technical work of ISO/IEC JTC1 on Information Technology, Third Edition 1995.
ISO/IEC TR10000-1:1992	Information technology - Framework and Taxonomy of International Standardized Profiles - Part 1: General principles and documentation framework, third edition, 1995.
ISO/IEC TR10000-2:1992	Information technology - Framework and taxonomy of International Standardized Profiles - Part 2 : Principles and Taxonomy for OSI Profiles, third edition.
ISO/IEC 8632-1:1994	Information Technology - Computer Graphics Metafile for the Storage and Transfer of Picture Description format - Part 1: Functional Specification
ISO/IEC 8632-2:1994	Information Technology - computer Graphics Metafile for the Storage and Transfer of Picture Description format - Part 2: Character Encoding
ISO/IEC 8632-3:1994	Information Technology - computer Graphics Metafile for the Storage and Transfer of Picture Description format - Part 3: Binary Encoding
ISO/IEC 8632-4:1994	Information Technology - computer Graphics Metafile for the Storage and Transfer of Picture Description format - Part 4: Clear Text Encoding
ISO/IEC 8632:1992	AMD.1:1994 - Parts 1-4: Rules for Profiles
ISO/IEC 10918-1:1994	Information technology - Digital compression and coding of continuous-tone still images : Requirements and guidelines
ISO/IEC 10918-2:1995	Information technology - Digital compression and coding of continuous-tone still images : Compliance testing

ISO/IEC 10918-3:DIS	Information Technology; Digital Compression and Coding of Continuous-Tone Still Images; Part 1: Extensions
ISO/IEC 10918-4:DIS	Information Technology; Digital Compression and Coding of Continuous-Tone Still Images: Part 4; Registration Procedures for JPEG Profile, APPn Marker, and SPIFF Profile ID Marker
ISO/IEC 9973:1994	1st Edition, Procedures for Registration of Graphical Items
ISO/IEC 11072:1993	Information technology - Computer graphics - Computer Graphics Reference Model
ISO/IEC 12087-1:1995	Information technology - Computer graphics and image processing - Image processing and Interchange--Functional specification Part 1: Common architecture for imaging
ISO/IEC 12087-2:1994	Information technology - Computer graphics and image processing - Image processing and Interchange--Functional specification Part 2: Programmer's imaging kernel system application program interface
ISO/IEC 12087-3:1995	Information technology - Computer graphics and image processing - Image processing and Interchange--Functional specification Part 3: Image Interchange Facility (IIF)
ITU-T T.4 (1993:03)	Standardization of Group 3 Facsimile Apparatus for Document Transmission, AMD2 08/95

Definition of Acronyms

ARIDPCM	Adaptive Recursive Interpolated Differential Pulse code Modulation
BIIF	Basic Image Interchange Format (ISO/IEC 12087-5 DIS)
CGM	Computer Graphics Metafile
DGIWG	Digital Geographic Information Working Group
ISMC/GSMC	Imagery Standards Management Committee / Geospacial Standards Management Committee
IEC	
ISO	International Standards Organization
ISP	International Standardized Profile
JPEG	Joint Photographic Experts Group
NSIF	NATO Secondary Imagery Format
NITF	National Imagery Transmission Format
SDE	Support Data Extension
STANAG	Standardized Agreement
TACO2	Tactical Communications Protocol 2
USIGS	United States Imagery and Geospacial System

THE NITFS "ROADMAP"

There is an ongoing effort to develop an international standard (ISO 12087-5 BIIF) based on the past experience and capabilities of NITF. Significant interest has been displayed by other nations to adopt the basic structure and capabilities of NITF as a common format for the exchange of imagery products. For example, the North Atlantic Treaty Organization (NATO) nominated NITF as the basis for developing a parallel, yet technically identical standard for the exchange of imagery products among secondary systems; similarly, the Open Skies nations have agreed to implement the identical format for imagery exchange among their systems.

The approach is for the US, NATO, and other interested entities (e.g. medical, law enforcement, agriculture, etc.) to develop and register profiles of applicable international standards for use in acquisition and implementation. Since the suite of international standards and profiles will not be finalized simultaneously, the interim approach is to document intended usage as a military standard in the US (Mil-Std-2500B) and as a Standardization Agreement (STANAG 4545) in the NATO arena as the technically identical standard is developed within the ISO (ISO 12087-5, BIIF). This approach provides documentation suitable for acquisition purposes while the community awaits for ISO 12087-5 to at least become established as a Draft International Standard (DIS). Likewise, MIL-STD 2301, MIL-STD 188-198 and MIL-STD 188-196 will continue to serve as definitive acquisition documents until approved profiles for the ISO CGM standard, JPEG standard, and Bi-level Standard are registered internationally and their use is under some level of configuration management by the Imagery Standards Management Committee/Geospacial Standards Management committee (ISMC/GSMC) as well as the National Imagery and Mapping Agency (NIMA).

Table 4-1 below lists the standards that are currently specified under the NITFS umbrella, and the expected international standards (and standards profiles) that will supersede them in the future. Significant time has been spent to ensure that, during the transition from the suite of military standards to registered international standards profiles (ISP), backward compatibility to legacy NITF products can be maintained. Also, technically, the ISPs are identical to their military standards counterparts, to assure a seamless transition for the USIGS community of users.

	Standard	Current NITFS Specified standard	Anticipated International Standard/profile	Effectivity of changes to existing standard	Anticipated impact to existing implementations
File Format	NITF 2.1	MIL-STD 2500B	ISO 12087-5 ISP	1 Oct 98	Major additions and deletions
File Format	NITF 2.0	MIL-STD 2500A	N/A	N/A	N/A
Computer Graphics	CGM	MIL-STD-2301	ISO 8632 ISP	1 Oct 98	Addition of new CGM
compression	JPEG Baseline (lossy)	MIL-STD-188-198	ISO 10918-1 profiles	1 Oct 98	None/minor
compression	JPEG Lossless	N/A	ISO 10918-1/4 profiles	1 Oct 98	New capability
compression	Bi -Level	MIL-STD-188-196	CCITT Recommendation T.4	1 Oct 98	None/Minor
compression	Vector Quantization	MIL-STD 188-199	ISO 12087-5 ISP	1 Oct 98	None/Minor
compression	ARID PCM	MIL-STD 188-197	N/A *see discussion below	N/A	N/A
Comm. Protocol	TACO2	MIL-STD-2045-44500	N/A *see discussion below	N/A	N/A

Table 4-1 NITFS Standards transition Table

The Adaptive Recursive Interpolated Differential Pulse code Modulation Image compression (ARIDPCM), removed as a required compression for the NITF 2.1, is now only required for use with decompressing legacy files (NITF 1.1, 2.0) that implement it. Hence, MIL-STD 188-197A will continue to be theauthoritative standard until such time that these legacy imagery products have been converted to other accepted compression alternatives (JPEG, No compression, etc.).

The Tactical Communications Protocol 2 (TACO2) for the NITFS, MIL-STD-2045-44500, establishes the requirements to be met by systems complying with NITFS when using the TACO2 protocol. It defines the protocols and formats that make up TACO2 and addresses issues concerning functional interoperability. Additionally, it provides for TACO2 operation aspects that are not strictly related to interoperability but may affect technical performance or resistance to error. This standard has been a companion to the NITF as a result of the widespread use of NITFS in tactical environments, where communications lines have relatively low bandwidths (i.e. 2400 or 9600 baud) and where noise and interference are significant. As a result, there will continue to be a relationship between the need for TACO2 and NITFS implementation, weather it be for the NITF 2.1 or BIIF. In essence, the required implementation of the BIIF ISP will not impact users who need the TACO2. Until a viable alternative, non-proprietary commercial or international standard is available , the MIL-STD 2045-44500 will continue to be the sole guidance for TACO2 implementation with the NITF/BIIF. The NITF community looks to those organizations providing communications services to provided these much needed solutions so that the capabilities TACO2 may also migrate to the commercial/international arena.

In the case of the Bi-level compression, the military standard describes the one-dimensional and two-dimensional image data compression strategy articulated in the International Telecommunication Union (ITU), CCITT Recommendation T.4, *Standardization of Group 3 Facsimile Apparatus for Document Transmission,* (Geneva, 1980, amended at Malaga-Torremolinos, 1984 and Melbourne, 1988) and establishes its application within the NITFS. Since the ITU standard provides the exact requirements for implementation of the bi-level compression algorithm, a specific USIGS profile is not required; the ITU document itself provides the necessary technical guidance for implementing this standard.

As the desired ISO standards is approved (i.e., become International Standards), Mil-Std-2500B and STANAG 4545 will be replaced by an ISP of ISO 12087-5. In the meantime, every effort has been made to keep the Mil-Std-2500B and STANAG 4545 draft documents in technical synchronization, both mutually and with the evolving draft of ISO 12087-5. To ease the transition of systems fielded with NITF2.0, significant effort has been made to posture the BIIF, NITF2.1 and NSIF specifications such that an implementation profile of these specifications could be essentially equal to NITF2.0 at the binary file level. This goal has been met with just a few minor exceptions as shall be discussed further in this document. These exceptions deal primarily with issues such

as the Year-2000 problem, the new Executive Order for security/classification markings, simplification of features, and several modifications needed to obtain international consensus for the use of the format. See section 6. for specific details.

A final issue revolves around the large numbers of legacy NITF 2.0 files that will need to be maintained as NITF 2.1 implementations become fielded. It is clear that the Digital archives/libraries are going to contain NITF 2.0 files for a long period a of time. As a result, the following key points need to be stressed:

- *There is no intent to develop and register a NITF 2.0 ISP as will be done for NITF 2.1.*
- *The requirement to unpack NITF 2.0 files will continue for an indefinite period of time, as long as the large number of NITF 2.0 files exist and are required*
- *The requirement to pack NITF 2.0 files will continue for as long as there are NITF 2.0 systems that have not yet upgraded to NITF 2.1/BIIF ISP. As a result, NITF 2.1 implementations must continue to support the creation of NITF 2.0 files until TBR01 Date/Year, ensuring interoperability with systems not yet upgraded.*
- *The existing suite of military standards for the NITFS 2.0 will continue to be the authoritative procurement and development document for the implementation of NITF 2.0 readers.*

As the Certification and compliance testing requirements for the NITF 2.1/BIIF ISP become mature, and a date (TBR01) is established, NITF 2.0 support by NITF 2.1 systems will become clearer.

Table 4-2 summarizes which standards under the current NITFS suite will have to be registered under the ISO process, and which ones will remain under the current DoD process. See section 4 for additional details. There are issues remaining in terms of how the ISO/IEC TR10000 series of documents define the profile registration process for ISPs, and its relationship to the JPEG part 4 document, which also defines a process for JPEG profiles. Details of this will be forthcoming (TBR16).

	Anticipated USIGS Standard	ISO Registration Authority	CM authority for DoD/IC
NITF 2.1	ISO 12087-5 ISP	ISO JTC1	NIMA / I-GSMC
NITF 2.0	MIL-STD 2500A	N/A	NIMA / I-GSMC
CGM	ISO 8632 ISP	ISO JTC1 and NIMA [A]	NIMA / I-GSMC
JPEG	ISO 10918-1 profiles	ISO JTC1 and AFNOR [B]	NIMA / I-GSMC
Bi-level	CCITT Rec. T.4	ISO JTC1 and AFNOR	NIMA / I-GSMC
VQ	ISO 12087-5 ISP	ISO JTC1	NIMA / I-GSMC
ARIDPCM	MIL-STD 188-197	N/A	NIMA / DISA / I-GSMC
TACO2	MIL-STD-2045-44500	N/A	NIMA / DISA / I-GSMC

Table 4-3 Configuration control of standards

Finally, Table 4.3 below provides a look at emerging standards that will be incorporated into the NITFS/BIIF suite once adopted. This list will be periodically updated , as the documents and technologies are developed. More detail on these emerging standards are provided in section 15, Emerging Standards for the NITFS/BIIF suite

	Standard	**Organization developing the Standard**	**Effectivity for inclusion into the NITFS suite**
compression	JPEG Multicomponent	ISO	E03
compression	JPEG 2000	ISO	E04

Table 4-3 Emerging standards for inclusion into the NITFS

[A] NIMA has been proposed as the authority for the registration of new CGM; ISO JTC1 Will be the registration authority for CGM ISPs

[B] AFNOR is the proposed registration authority for profiles of the JGEB standard (ISO/IEC 10918-1); ISO/IEC 10918-4 defines the AFNOR profile registration process. Details of this relationship will be defined in the future as well as differences in terminology (i.e. need for an ISP for BIIF, but a profile for JPEG) are made clear (TBR16)

The National Imagery Transmission Format Standard - Background

The National Imagery Transmission Format Standard (NITFS) is the collaborative result of a US Government and Industry effort to provide a common facility for exchanging imagery, imagery derived information, and associated geospacial metadata. The purpose of the NITFS is to provide a common standard for the exchange and storage of files composed of images, symbols, text, and associated data.

Technical review, community coordination and overall planning of the NITFS has been accomplished through the NITFS Technical Board (NTB) and its ad-hoc working groups, such as the Format Working Group (FWG), Bandwidth Compression Working Group (BCWG) and Communications Working Group (CWG). The NTB has evolved over the years into a true consensus-based forum emphasizing cooperation and partnership between government and industry. The NTB operates under the authority of the Imagery Standards Management Committee and Geospacial Standards Management Committee ISMC/GSMC, which is responsible for the selection and management of imagery and geospacial standards for the DoD, IC, and overall USIGS community.

NITF 1.0 (1984 - 1990)

By 1984, the need for a standard data format became obvious, and a project was initiated to develop such a format. The original goal was to develop a co-standard that could be added to all of the existing systems and incorporated into new systems during their acquisition phases. The original result of this effort was version 1.0 of the NITF which was never implemented or fielded. The NTB was officially established at this point to continue and manage the technical development, validation, certification and integration of the format into DoD. A Defense Support Project Office (DSPO) representative was appointed to manage and co-chair the NTB. An Intelligence Communications Architecture (INCA) project Office representative was appointed to manage validation, certification, and testing, as well as to co-chair the NTB.

NITF 1.1 (1989-1994)

Version 1.1, an improved format, was developed, validated and proposed as the implementation baseline. The NITF Configuration control Board (NCCB), chaired by a representative from the Office of the Assistant Secretary of defense (OASD) for Command, Control, Communications, and Intelligence (C3I) approved Version 1.1 for general implementation in March 1989. In 1990, a certification test facility was established in the Washington, D.C. area, under INCA sponsorship, but was moved to the Joint Interoperability Test Center (JITC), Fort Huachuca, Arizona, in 1991 when the Defense Intelligence Agency (DIA) assumed INCA's responsibilities. By March 1992, over thirty different system configurations had been tested as compliant with NITF version 1.1.

NITFS / NITF 2.0 (1994 - 2000)

Development of an improved version of the NITF, intended to address problems found with previous versions, was initiated in 1988. Initially, the new version was called NITF 2.0. A key improvement was the inclusion of communications support that would enable NITF to be transmitted over tactical circuits. This communications support was provided via the definition of the Tactical Communications Protocol 2 (TACO2). Additionally, improved image compression, forward error correction, and enhanced graphics algorithms began development. In May 1989, the Chairman of the Committee on Imagery Requirements and Exploitation (COMIREX) directed the adoption of the NITF as the Intelligence Community standard for the transmission of secondary images. In 1991, the OSD directed that NITF be documented as a DoD Standard, and its name was changed to the National Imagery Transmission Format Standard (NITFS). The NITFS encompasses not only the NITF 2.0 file format, but also compression algorithm standards (i.e. JPEG, ARIDPCM, Bi-LEVEL, VQ), computer graphics standards (CGM), and communication protocol standards (TACO2). By 1994, the NITFS was being implemented in a variety of systems that went beyond the "secondary imagery dissemination" capability; infact, currently, all or components of the suite of standards are or will be implemented by a variety of components within the USIGS Technical Architecture, including: primary imagery dissemination systems, Unmanned Airborne Vehicles (UAV), digital imagery and geospacial archives and libraries; and commercial satellite vendors. As of March 1997, an estimated ***TBR02*** commercial vendors have developed NITF compliant systems. Additionally, an estimated 13000 software licenses have been sold by industry providing commercial products supporting NITF 2.0.

NITFS / NITF 2.1 (1998 - Present)

A number of factors have driven the changes made to NITF 2.0 during recent years. Among these are: the creation of the National Imagery and Mapping Agency ; the mandate for the selection and implementation of commercial/international standards over government/ military standards where possible; user requirements for improved fusion of information, whether imagery, geospacial, or other data type; and the ever increasing need to share data within and external to systems of the DoD/IC. NITF 2.1 is based on extensive coordination among NITFS users within the USIGS community, NATO and Allied Nations, as well as with commercial vendors and groups dealing with related standards and technologies. This section summarizes changes made to the existing NITF 2.0 baseline in support of the proposed NITF 2.1 as well as the NSIF and BIIF standardization efforts.

The Request for Change (RFC) for NITF2.1, which will create MIL-STD 2500B, has been reviewed by the USIGS community, and, through the NSIF and BIIF documents, NATO and ISO SC24/WG7, respectively. This large scale review has ensured that MIL-STD2500B is technically aligned with the other two documents. In addition, the quality of the document, from the editorial and organizational perspective, has improved considerably by having a widespread review by international readers.

The date planned for MIL-STD 2500B effectivity is 1 October 1998. The time from now until 1 Oct 1998 will provide system developers, Program Management Offices, and Commercial vendors enough time to make changes to their baselines or procure new products and applications. Some commercial and government NITF users have already begun to make appropriate changes as the draft document has developed. Others will require a significant time to assess the cost to make the changes, and implement the changes, and then re-validate their compliance to the standard.

Below is a summary of changes being made to NITF 2.0 in support of NITF 2.1.

Deleted features, capabilities, and constraints of NITF 2.1

The following paragraphs identify the features, capabilities, and implementation constraints of NITF2.0 implementations that are no longer applicable once NITF2.1 becomes mandatory for implementation.

NITF1.1 compatibility

There is no longer a mandatory requirement for full NITF1.1 backward compatibility. However, NITF2.1 implementers should consider continued support for the interpretation of legacy NITF1.1 files that may be archived.

ARIDPCM Compression support

The ARIDPCM compression algorithm is no longer used except as it may appear in archived NITF1.1 files. See Section 4. (table 4-1) for additional discussion.

File Size Constraints.

The following file size constraints imposed on NITF2.0 implementations are eliminated for NITF2.1 files:

- Maximum file size limitation for compliance level 01 files of 1.2 megabytes.
- Maximum file size limitation for compliance level 06 files of 2 gigabytes.

Display Level Constraint.

The constraint that the image, symbol, or label segment with the lowest display level must be positioned at the origin of the common coordinate system has been eliminated for NITF2.1 files.

Pre-Positioned Default JPEG Tables implementation

The use of the Compression Rate (COMRAT) field to designate pre-positioned default Quantization and Huffman tables has been eliminated. JPEG tables will always be included as part of the compressed image. For implementations lacking the ability to generate tables customized for specific images, a set of 'default tables' for different image types (VIS, SAR, IR, Color) has been defined in the standard. The appropriate default tables are to be included in the JPEG stream when custom tables are not available.

Symbol Segments use

The use of the "SYMBOL" segment construct is now constrained to use only Computer Graphics Metafile (CGM) encoded symbols.

Raster or Bit-mapped symbol segments support.

Raster or Bit-mapped symbol segments are no longer supported. The equivalent functional capability can be accomplished by using the bi-level (single bit-per-pixel) raster image capability of the "IMAGE" segment construct. This also allows for Bi-Level compression of a bit-mapped raster not previously supported for bit-mapped symbols. There is no longer a reference to, or anticipation of, the future use of "OBJECT SYMBOLS".

Label Segments use.

The "LABEL" segment construct has been eliminated in NITF2.1. A place holder in the file header has been retained to preserve header structure compatibility with NITF2.0, but its use is now reserved for future purposes.

Modified features, capabilities, and constraints of NITF 2.1

The following paragraphs identify the features, capabilities, and implementation constraints of NITF2.0 that have been modified in NITF2.1.

Header Field Types.

The NITF header and subheader fields are no longer designated as being 'Required/Optional/Conditional'. They are now designated as being either 'Required' or 'Conditional'. Specification of more definitive value ranges for fields obviate the need for designating some fields as being 'optional'.

File Profile Name and Version.

There is a modified convention to mark files for the applicable version of NITF. This is being done in anticipation of the proposed international standard, 12087-5 Basic Image Interchange Format (BIIF); and STANAG 4545, NATO Secondary Imagery Format (NSIF). The first nine characters (bytes) of the file (the FHDR field) now portray the profile version of the underlying standard identified in the four characters (bytes) of the Standard Type (STYPE) field (previously the unused System Type field). NITF2.1 Implementations will be expected to handle the following:

- "NITF01.10" Legacy NITF Version 1.1 files.
- "NITF02.00" Legacy NITF Version 2.0 files.
- "NITF02.10" NITF Version 2.1 files.
- "NSIF01.00" NSIF Version 1.0 files.

Note: The intent is for "NITF02.10" and "NSIF01.00" to be treated as aliases.

Compliance Level.

The field previously called 'Compliance Level' is now called 'Complexity Level'. Whereas NITF2.0 was implemented with seven compliance level codes (01, 02, 03, 04, 05, 06, 99); NITF2.1 (NSIF1.0) will initially use four complexity level codes (03, 05, 06, 99).

Standard Type.

The NITF2.0 System Type (STYPE) field was previously unused (always filled with spaces). This field has now been redesignated as the Standard Type (STYPE) field. For NITF2.1 and NSIF1.0 designated files, it will contain the version of ISO BIIF applicable to those profiles, i.e. BF01. To ease transition, implementations of NITF2.1/NSIF1.0

should be forgiving if this field is received with spaces rather than with 'BF01'.

Date and Time.

The date and time field in the file header and segment subheaders has been modified to include century information to help cope with the year 2000 transition. To keep the field length the same as that used for NITF2.0, the month is designated as a numeric (01-12) vice an alphabetic (Jan - Dec) representation. The 'Z' indicator for UTC (ZULU) time is no longer included in the field, but all times are to be expressed using the UTC time zone.

Security Downgrade Dates.

To avoid modifying the field length, century information has not been added to the security downgrade fields. The dates in these fields must be interpreted in light of the century information contained in the corresponding date and time field of the header or subheader in which the security downgrade date is contained.

Block Shape and Size.

In the past, NITF implementations were limited to only using square blocks in multi-blocked images. Additionally, allowable block sizes were constrained to discrete sizes (32x32, 64x64, … 1024x1024). Block shapes can now be rectangular and of variable size across the ranges designated for each complexity level.

Image Coordinate System.

The image coordinate system fields (ICORDS and IGEOLO) in the image segment subheader have been modified for improved clarity of use.

Transparent Pixels.

The concept of 'transparent pixel' has been renamed to 'pad pixel' to better reflect the intended concept. A new concept of designating a specific pixel value as being 'transparent' has been added.

JPEG Compression.

The structure of JPEG Application Markers has been modified to align with international profile registration constraints.

JPEG Compression (12-bit).

All NITFS read capable implementations must now support 12-bit JPEG decompression of single band images.

VQ Decompression.

All NITFS read capable implementations must now support decompression of Vector Quantization (VQ) compressed image segments.

Tagged Record Extensions.

The physical separation for "registered tags" and "controlled tags" between "user defined" and "extended" fields in the file header and image subheader is no longer required. Either type of tag may appear in either area, thus doubling the space available to contain tagged record extensions. Removal of this restriction now allows registered tags to appear in symbol and text subheaders which have no user defined fields. Tagged record extensions must still be placed in the subheader of the segment for which the extension pertains or in the file header if the extension pertains to multiple segments or to the whole file.

New Features and capabilities for NITF 2.1

The following is a summary of features considered to be new to NITF

Universal Multiple Octet Coded Character Set (UCS).

Although the character codes in header and subheader fields are still constrained to eight bit codes, the standard now allows the selection and use of UCS character set(s) within the text data field of the text segment.

Number of Bands.

A new conditional field (5 bytes) has been established to allow for multi-spectral images of more than 9 bands.

Multiple 'Base' Images in a Single File.

The NITF2.0 paradigm of only allowing a single base image per NITF file has been expanded. Through the appropriate placement of images within the common coordinate system and the proper association of attachment and display levels, the single file paradigm has been expanded to allow multiple base images, each with its own set of associated overlays.

Multiple File Products.

NITFS products consisting of multiple cross correlated NITF files are now being produced (e.g. CADRG, CIB, DPPDB, files split at 2GB boundaries, Rsets, etc.) in NITF2.0 format. As a minimum, NITF2.0 interpreters were only expected to read single files from these products. NITF2.1 implementations should look toward full interpretation and user presentation of multiple file products. Additionally, further expansion of the multiple file product paradigm is anticipated.

Symbol Bounding Rectangles.

Unused fields in the symbol subheader have been redefined to allow for definition of a virtual bounding rectangle within which all visible components of a CGM symbol are contained.

Symbol Color.

The symbol color field has been redefined to express whether the CGM symbol is entirely monochrome or if it has color components.

Transport File Structure.

A new Military Standard has been created defining the Transport File Structure for use within a Data Extension Segment (DES).

"Caboose" Extension Concept.

A ability to allow initiation of NITF file transmission prior to having all the information needed to complete the file header has been added.

Geospacial Extensions.

A set of Spatial Data Extensions has been added to the standard. These elements are defined based on agreement among a number of activities within and external to the NIMA, including NATO, the FGDC, and commercial entities.

Lossless JPEG

The lossless JPEG standard, as defined in ISO/IEC 10918-1, will be profiled for NITFS users, as defined in ISO/IEC 10918-4 (DIS). Additional discussion of this new compression option is in section 9,; the actual (proposed) profile is provided in Annex C, as well as listed as an example in the ISO/IEC 10918-4 DIS.

Interim Low Bit Rate Compression

This capability complements the current Lossy JPEG compression algorithm by providing for the downsampling (and upsampling) of an

NITF image, prior to JPEG compression (or after decompression). The upsampling/downsampling reduces the size of the image such that compression rates above the 20:1 can be realized while still maintaining utility to users. This standard is meant for users who do not require high quality "exploitable" imagery, but do require recognizable imagery for transmission over reduced bandwidth communications links. This pre/post processing technique will be defined as a profile to ISO/IEC 10918-1, as well as being defined in an ISMC TBR03 document ("Bandwidth Compression Guidelines for the NITFS/BIIF)."

Addition of new JPEG Huffman and Quantization Tables

RGB Color and optimized 8-bit and 12-bit JPEG Quantization and Huffman tables for the three image types: IR, SAR, and visible, have been provided. As per the new NITF 2.1 requirement to always embed tables into the NITF/JPEG stream, these tables will be defined as "recommended" tables, vice "default" tables as used with NITF 2.0. The specific tables are available on the NITFS WWW Page (http://www-ismc.itsi.disa.mil/ntb/ntb.html) and will be defined in an ISMC TBR04 document ("Bandwidth Compression Guidelines for the NITFS/BIIF)."

Features in BIIF that impact full binary compatibility with NITF 2.0.

The following is a summary of the differences between legacy NITF2.0 files and the BIIF standard that impact the possibility of creating an NITF2.0 profile of BIIF (if the community chooses to do such a thing) which is exactly binary compatible with legacy NITF2.0:

STYPE Field.

NITF2.0 always placed four space characters in this field. A truly BIIF compliant file will have 'BF10' in this field. Existing NITF2.0 applications may need to be modified to ignore this field if populated with 'BF10'. BIIF applications will need to be forgiving if this field is populated with spaces.

Date and Time Fields.

The data and time representation in BIIF has been modified from that in NITF2.0 to include the century designation. Existing NITF2.0 applications will need to be modified to recognize the new date/time format. BIIF applications will need to be forgiving and recognize the legacy date/time format.

Conditional Field for Security Downgrade events.

No impact on NITF2.0 applications receiving NITF2.0 profile BIIF files. BIIF applications receiving legacy NITF2.0 files will need to anticipate the existence of the conditional field, even though not specified in BIIF.

Label Segments.

NITF2.0 systems would need to exclude label segments from files sent to NITF2.0 BIIF profile capable systems. Since it is the general practice of most NITF2.0 implementations to use CGM text (symbol segments) vice label segments, the potential for impact on field use is minimal.

Extensions.

BIIF does not explicitly differentiate between "controlled" and "registered" extensions. Nor does it constrain their physical placement between user-defined and extended header fields. The NITF 2.1/BIIF ISP will need to include this restriction.

BASIC IMAGERY INTERCHANGE FORMAT

Background

The Basic Image Interchange Format, ISO/IEC 12087-5 (BIIF) utilizes the concept of International Standard Profiles (ISPs) as established by ISO/IEC TR 10000-1 Third Edition, 1995-12-15. Registering an ISP is the standardized means for tailoring BIIF for use by communities of interest that have different functional scopes that suit a variety of user requirements. BIIF has many options; the use of which are constrained for implementation to achieve file exchange interoperability within a designated community of interest. A BIIF ISP allows inclusion of data types defined by external profiles (e.g. profiles of ISO/IEC 12087, registered ISO profiles external to 12087, and other approved standards documents and registered items). Finally, use of BIIF provides an additional means of extensibility through the registration of tagged and encapsulated extensions.

Current Status

A Model Profile is prescribed in a normative annex to the BIIF standard (Annex C). This Model Profile consists of a set of proforma tables that are used as templates for specifying an international standardized profile of BIIF.

By referring to the Model Profile Performa as the starting point and simply identifying capabilities and their constraints, new profiles may be developed and nominated for registration. Although the inclusion of the Model Profile within registered profiles is not mandatory, it is a minimally conformant use of BIIF. Inclusion of the Model Profile for implementation in conjunction with other profiles promotes an increased potential for a basic level of interoperability and data portability among implementations of differing BIIF profiles. This basic level of interoperability is achieved by providing an implementation option that allows the user to limit the content of BIIF files to the constraints of the model profile.

When developing a new ISP for a specific application domain, the Model Profile, existing ISPs and referenced content profiles (such as those for PIKS, CGM, JPEG, etc.) should be examined to determine if these meet the requirements for the targeted application domain. We may develop other profiles can be developed for communities with similar interests.

Annex A of this document contains the proposed USIGS ISP of the BIIF standard. Until such time that the ISP is approved and registered by the appropriate ISO Registration authority, the profile listed here will be configuration managed as part of this document in support of ongoing development and registration activities. This candidate ISP shall be used for any implementations of the BIIF standard within but not limited to the USIGS. When the BIIF ISP is approved, the registered ISO ISP shall supersede Annex A of this document for development and procurement purposes.

NATO Secondary Imagery Format (NSIF)

Background

The NATO Air Group IV recognized in 1995 that there was a current requirement to develop an imagery format Standardization Agreement (STANAG) for imagery that had been exploited. The term normally used for this type of imagery is "secondary" and is intended to be provided from an exploitation center to operational forces. NATO Air Group IV previously developed a series of STANAGS to satisfy their primary imagery format and recording standards. The remaining STANAG to be developed was for secondary imagery.

In May 1995 the Standards Branch of the then Central Imagery Office was contacted by representatives from Rome Air Development Center and asked if CIO could provide technical expertise and advise to aid NATO in preparing a standard similar to the U.S. National Imagery Transmission Format Standard (NITF). Members of the CIO Standards Branch attended the first Technical Support Team (TST) meeting held in Ann Arbor, MI. The purpose of this was to establish the Terms of Reference and the Work Plan to develop the Secondary Imagery Format Standardization Agreement. In addition to the United States, representatives from France, Germany, Italy and the United Kingdom were present. Each nation had its own interest in what this new STANAG should include. The French wanted to ensure that geospatial information was included as part of the STANAG. The United Kingdom's interest was in preserving the Primary Imagery STANAG, STANAG 7023, and not to mix primary and secondary imagery formats within a single STANAG. The Germans were interested in interoperability and the possible impacts on a standard imagery ground station within NATO. The results of this meeting were significant. A detailed Work Plan and the Terms of Reference for the effort were outlined. An aggressive schedule was established with a goal to prepare the basic STANAG for ratification by October 1996. The work was to be undertaken jointly by all attendees with the U.S. leading the TST and responsible for the basic format requirements. The French were tasked to develop the geospatial requirements based on work within the Digital Geographic Information Working Group (DGIWG) and the Germans were tasked to develop overall structure of the STANAG. The United Kingdom was tasked to concentrate on the unique characteristics of the secondary image product and ensure that the existing primary imagery format was kept separate.

The Technical Support Team held meetings quarterly from May 1995 until April 1997. Each of these meetings moved the process of defining the requirements for the Secondary Imagery Format STANAG toward consensus. The early meetings, July and October 1995 and March 1996 were involved with

the development of the resolution of major national issues concerning scope and direction of the STANAG. An agreement was achieved at the March 1996 meeting to move forward with the proposed STANAG based essentially on the NITF with major input from the DGIWG to incorporate the geospatial requirements and procedures. After this milestone was achieved, the document began to take shape. In addition to the regularly scheduled TST meetings, NSIF Editor meetings were planned every 6 to 8 weeks to develop the document to meet the schedule for the ratification draft, 1 October 1996. Work progressed with tremendous support provided by all national bodies. By now, CIO had been incorporated into NIMA and NIMA took the lead in getting the document from rough drafts through the entire development process. The group was successful in providing a Draft Version 0.9 by 1 October 1996. There were still some technical issues that could not be resolved with the German and French delegations. At the October 1996 NATO Air Group IV meeting, the TST Leader recommended a slip in submission of the formal ratification draft until the April 1997 meeting. Air Group IV agreed to the delay, but directed the TST to develop a detailed Work Plan for a way forward following submission of the ratification draft. This Work Plan for Phase II was to include completion of all items specifically excluded from the original Work Plan for Phase I. These items included the addition of bandwidth compression, computer graphic metafiles, audio and video, and the development of an International Standardized Profile of the ISO 12087-5, Basic Imagery Interchange Format (BIIF) to meet the requirements of NSIF.

Following the direction provided at the October 1996 Air Group IV meeting, the TST held a series of editing meetings to complete the ratification version of NSIF. The document was presented to the Air Group IV on 8 April 1997 for ratification.

Current Status

The NATO Secondary Imagery Format, STANAG 4545, is currently being processed for ratification within the 16 nations that comprise NATO. Formal ratification is expected later this calendar year.

Air Group IV agreed to the proposed Work Plan for Phase II of NSIF. Phase II will focus its efforts on applying peripheral requirements to the basic framework such as: video/audio, data compression, Computer Graphic Metafile tailoring, and compliance and certification. The results of this phase of the Secondary Imagery Format Transmission effort will be to recommend specific implementations for STANAG 4545 to address the enhanced capabilities.

SIT/SID TST Phase II

The first stage or phase focused the initial efforts on providing a basic capability to exchange a still frame image with graphic overlays and associated textual reports. Phase I provided a framework for the encoding of multimedia data, suitable for NATO secondary imagery exchange. The resulting product of Phase I was NATO STANAG 4545 NATO Secondary Imagery Format. STANAG 4545 was developed in close liaison with: ISO SC24/WG7 (Basic Imagery Interchange Format - BIIF), US DoD Imagery Standards Management Committee/ Geospacial Standards Management committee (ISMC/GSMC), NATO Digital Geographic Information Working Group (IGEO/DGIWG), and NATO Command Control & Communication Agency (NC3A). Phase II will build on the Phase I effort and provide enhancements to the basic STANAG. Phase II will include the following tasks:

- tailoring of Computer Graphics Metafile (CGM) vector files,
- investigation of incorporation of 3D and geospatial based vectors,
- incorporation of video & audio clips,
- investigation into data compression,

continued coordination with NC3A, ISO SC24/WG7, DGIWG and ISMC/GSMC and related NIMA Configuration Boards,

- compliance & certification.

Four parallel tasks are defined under Phase II:

Format Task - United States lead

- inclusion of Transportable File Structure (TFS)
- investigation of adopting of formatted text within text segment
- development of configuration management plan
- development of certification & compliance guidance
- coordination with ISO, NATO and US groups
- format global oversight
- editing documentation

Video/Audio - United Kingdom lead

- encapsulating video and audio clips into NSIF framework

(candidate; MPEG 1, MPEG 2)

Bandwidth Compression - Germany lead

- defining compression algorithms for video, imagery, & graphics

(candidate: JPEG, Bilevel, VQ & other)

Vector - France lead

- tailoring Computer Graphic Metafile to meet NSIF requirements
- investigating the adoption of geospatial based and 3D vectors

(candidate: CGM, VPF)

Generation of BIIF profile - UK, US lead

- Developing an International Standardized Profile (ISP) of BIIF using NSIF as the basis. This work will be lead by Mr. Martin Smith, United Kingdom, the NATO Liaison to ISO SC24. He will be supported by the rest of the TST, particularly the United States.

Schedule

The Phase II efforts were approved on 8 April 1997. The effort will continue through September 1998. As done during Phase I, the TST will schedule quarterly meetings with Editing Meetings to be called as needed to progress the documents. It is anticipated that meetings will be held regularly every 6-8 weeks between now and 1 October 1998. A detailed plan of work with detailed schedules for each task will we completed at the next TST meeting currently scheduled for the end of June 1997.

The development of a NATO profile will commence as soon as BIIF is approved as a Draft International Standard, currently planned for the end of calendar 1997. Specific profiles for each of the other tasks included in Phase II will be planned to coincide with the parallel development of similar profiles to support NITF and its ISP of BIIF.

Bandwidth Compression Standards

The NITFS 2.0 suite of standards includes a number of bandwidth compression standards, some of which are based on ISO adopted standards:

- MIL-STD 188-198A Joint Photographic Experts Group (JPEG) Image Compression for the National Imagery Transmission Format Standard *(JPEG lossy for NITFS)*
- MIL-STD-188-197 Adaptive Recursive Interpolated Differential Pulse Code Modulation (ARIDPCM) Compression Algorithm for the National Imagery Transmission Format Standard
- MIL-STD-188-196, Bi-Level Image Compression for the National Imagery Transmission Format Standard
- MIL-STD-188-199 Vector Quantization Decompression for the National Imagery Transmission Format Standard

MIL-STD 2500B deletes the requirement to support ARIDPCM compressed imagery, except for archived imagery, and defines JPEG, Vector Quantization and Bi-level as the valid compression techniques. An additional compression algorithm, not currently specified within the NITFS umbrella, is Lossless JPEG. It, as in the case of the Lossy JPEG standard, is specified in ISO 10918-1. That standard defines two classes of compression: those based on the DCT which are lossy, allowing substantial compression while producing a reconstructed image with high visual fidelity to the encoder's source image; and a second class of coding processes, not based on the DCT, and provided for applications requiring lossless compression.

The compression processes that will be supported in the NITF/BIIF standards, as listed above, are briefly described in the following sections. There are also a number of additional compression technologies being investigated in government and international standards fora for future, potential implementation by USIGS BIIF compliant systems; specifically JPEG-2000, JPEG-Multicomponent, and Complex Data Compression activity. These are discussed in section 15.

Lossy JPEG Standard

This Standard establishes the requirements to be met by systems complying with NITFS when image data are compressed using the JPEG image compression algorithm as described in DIS 10918-1, *Digital compression and Coding of Continuous-tone Still Images*. The requirements specified in the NITFS JPEG profile are intended to enable the interchange of 8- and 12-bit gray scale imagery and 24-bit color imagery compressed with JPEG. As part of the migration to International standards, a USIGS profile of the Lossy JPEG standard, technically identical to MIL-STD 188-198 will supersede the military standard. This profile is documented as an example in ISO DIS 10918-4, and will be registered as an approved profile of JPEG through the registration process as specified in 10918-4. This registration authority is the French Agency for Standardization (AFNOR). Annex B contains the profile for the

JPEG Lossy standard. When this profile is formally approved by the ISO Registration Authority as a valid profile, that profile shall supersede the profile defined in this document. The profile is technically equivalent to the Military Standard, and hence, will have minimal impact to existing systems implementing MIL-STD 188-198.

Lossless JPEG Standard

ISO Standard 10918-1 also defines a Lossless JPEG standard. The USIGS profile of this standard is documented as an example in ISO DIS 10918-4, and will be registered as an approved profile of JPEG through AFNOR. Annex C contains the profile for the Lossless JPEG standard. When this profile is formally approved by the ISO Registration Authority as a valid international profile, it shall supersede the profile defined in this document. There is currently no Military standard defining this capability. There is also no requirement within the NITFS (NITF 2.0) that mandates the implementation of Lossless JPEG at this current time. It is expected to become a mandatory implementation feature of NITF 2.1 and its BIIF ISP equivalent.

Bi-level compression

This standard establishes the requirements to be met by NITFS systems when image Data are compressed using the bi-level facsimile compression specified by the International Telecommunications Union (ITU) International Telegraph and Telephone Consultative Committee (CCITT) Recommendation T.4 and MIL-STD-188-161C for Group 3 facsimile devices. No attempt has been made to discuss image scanning, communication, or printing systems.

Vector Quantization

This standard establishes the requirements to be met by NITFS compliant systems when image data are decompressed using the Vector Quantization(VQ) algorithm. This allows NITFS-compliant systems to accept and decompress data that are compressed using a VQ compression scheme. This standard describes the VQ compression in the general requirements section, but does not fully describe the steps for compression. The decompression of VQ compressed maps and images is described in detail and is meant to fully describe the steps involved with VQ decompression. ISO 12087-5, BIIF, defines VQ decompression in a normative annex to the standard.

Computer Graphics Standards

Graphic data is used in the NITF to annotate imagery with two-dimensional information represented as a Computer Graphics Metafile (CGM). Examples of graphics are circles, ellipses, rectangles, arrows, lines, triangles, logos, unit designators, object designators (ships, aircraft), text, and special characters. A graphic is stored as a distinct unit in the NITF/BIIF file allowing it to be manipulated and displayed nondestructively relative to the images, and other graphics in the file. This standard does not preclude the use of n-dimensional graphics when future standards are developed.

The graphic format is CGM as described in ISO/IEC 8632-1, *Information Technology - Computer Graphics Metafile for Storage and Transfer of Picture Description, 1992.* The precise tailoring of the CGM standard to NITF is found in MIL-STD-2301. It is expected that an ISP for ISO/IEC 8632-1, for the USIGS / BIIF community, will replace the military standard when it is approved by the appropriate registration authority within ISO. Annex D contains the CGM ISP, and is the governing specification for CGM implementation within the NITF/BIIF standard. When the ISP is approved and registered within the ISO, it will supersede the profile contained herein.

Support Data Extensions

Support Data Extensions are used in NITF, NSIF and BIIF to provide implementers the flexibility to include value-added data or information about the file or the image(s) within the file. Extensions are a necessary part of the "core" format to support the various requirements of USIGS users that may not be directly supported by the common portion of the base standard; each user of an NITF file has their own specific data they need to obtain, and have different and unique requirements as to what is done with the NITF imagery and associated metadata (i.e., mensuration, report generation, advanced data processing, etc.). Within NIMA, control and registration of proposed extensions to NITF is vested in the Joint Interoperability Test Command (JITC) as the Executive Agent. A complete description of all currently approved extensions is maintained on the Internet Home Page for the JITC, and is also mirrored on the NIMA/NITFS homepage.

Current Extensions

The following are the significant sets of NITF extensions that have been defined since the inception of NITF2.0. The general philosophy of the past has been that NITF extensions are optional for implementation. All readers of NITF files were required to at least skip past extension data when attempting to read files with such data. Implementers of NITF2.1 should give renewed consideration to whether their customer base would be better served if extensions were more robustly supported.

PIAE.

The profile for imagery archive extensions (PIAEs) are used primarily to support the automatic archival and cataloging of imagery products. Any implementation with a requirement to feed imagery files to an imagery archive/library should support these extensions.

National Support Data Extension (SDE).

The Support Data Extensions (SDEs) provide data necessary for full interpretation and exploitation of national imagery.

Airborne EO/SAR/IR SDE.

These SDE, currently in draft, provide data necessary for the interpretation and exploitation of imagery from airborne collectors.

Geospacial Support Data Extension (SDE).

These SDE have been developed in coordination with NATO and the ISO TC211 groups, as well as the Digital Geographic Information Working Group (DGIWG). Its purpose is to extend the NITFS format

so that standard geospacial metadata can be included with imagery or associated data for use by imagery and geospacial users and applications.

RPF.

The Raster Product Format (RPF) extensions allow for a more robust interpretation and representation of several geospacial products (CADRG and CIB).

DPPDB.

Support for the Digital Point Positioning Data Base (DPPDB) extensions are essential for the proper interpretation and use of NITF formatted files produced in DPPDB products

ICHIPA

As mensuration and geopositional tools proliferate within the United States Imagery and Geospatial Information System (USIGS) environment and the use of NITF image chips continues to expand, the requirement for a "chipping tag" has been clearly evident. This tag provides users with the additional metadata required to mensurate on an image chip using applications such as RULER. This tag also supports the "chip of a chip" scenario

History Data Extension

This extension will provide a legacy record of the processing functions that have been applied to the image, thus providing the user with a description of the state of the image data at any point in the image chain.

Mosaic Tagged Record Extensions

A nomination is currently in progress to add a set of 'registered' tagged record extensions to the NITFS Tag Registry in support of mosaic imagery products. The purpose of these proposed tags (GHMOC and GHMFB) is to allow creation of an imagery product comprised of multiple images collected at differing times and under differing conditions while preserving meaningful access to the support data from each of the original collection activities. The current approach is to list these tags as 'registered only' until such time that the concept and tag specifications have been proven. Once the specification becomes stable, the intent is to convert the tags to a 'controlled' tag registration.

Extension Registry

The BIIF has simplified the concept and use of Tagged Record Extensions (TREs) by removing the historical separate placement area constraints for

'registered extensions' and 'controlled extensions' of the NITF2.0 era. TREs may be placed in either extension area of the header or subheader in which the TRE is to be placed.

BIIF also establishes a new paradigm of 'public' and 'private' extensions which is more typical of the needs in an international arena. Only public TREs need to be registered internationally. NIMA, through its agent, the JITC, will continue to maintain a registry of 'private' USIGS TREs. When circumstances warrant, selected USIGS TREs may be nominated for international registration as public TREs. The identifier fields of public TREs always start with an asterisk (*) character.

Within the domain of USIGS private TREs, a distinction will still be maintained between ‘registered only’ and ‘controlled’ TREs for purposes of configuration management of extension data within the USIGS private domain. This distinction will be maintained according to which registry list the TRE identifier appears. As done in BIIF, any TRE can be placed in either the user defined extension field or extended header field of the applicable file header or segment subheader for which the TRE applies.

Transition Schedules for NITF 2.1 and ISO profiles development and implementation

Figures 12-1 and12-2 provide the tentative schedules for a ratified IS and profile for BIIF, as well as for the profiles/ISPs of the other standards defined under the NITFS suite.

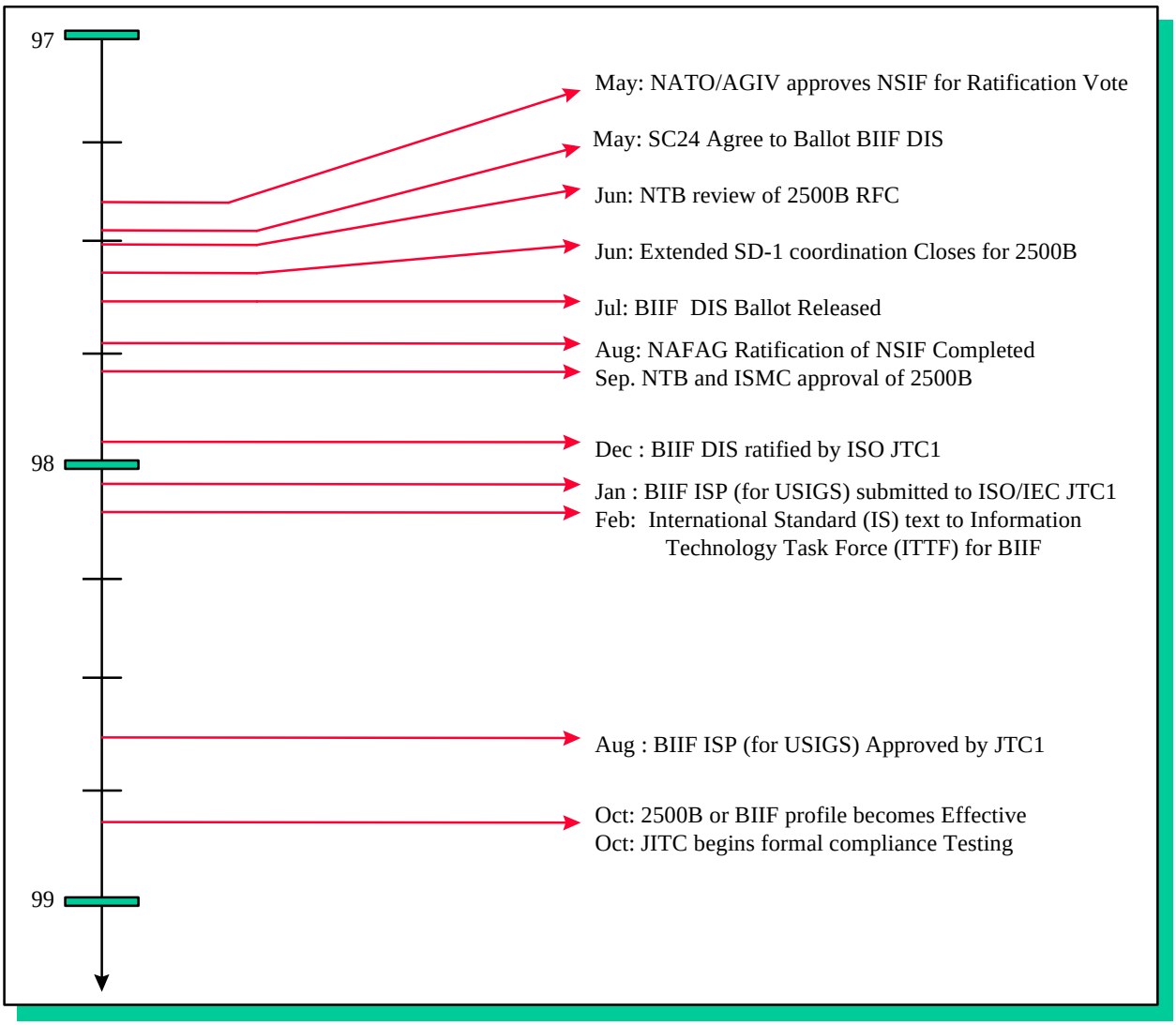

Figure 12-1 : Tentative Schedule for BIIF ISP development

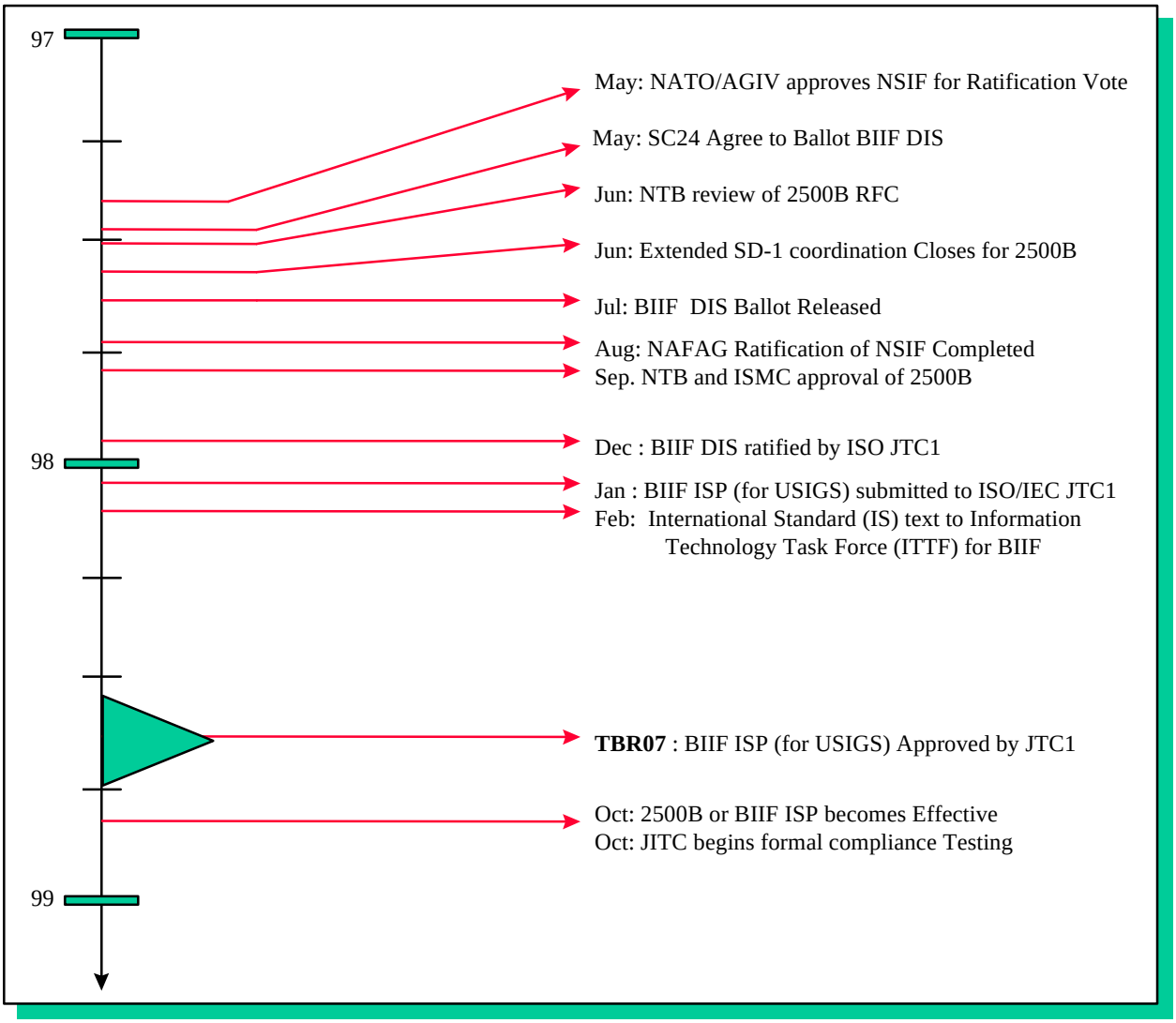

Figure 12-1 : Tentative Schedule for BIIF ISP development

As shown in figure 12-2, it is expected that proposed profiles for the BIIF Format, JPEG and Bi-level compression, and CGM graphics standards within the NITFS shall be developed and coordinated within the USIGS community of users during the Mid-1997 calendar year. Each of these international profiles shall have independent processes and schedules for formal approval and registration by the designated ISO/JTC1 authority. However, the profiles, as documented in the annexes of this document shall be the authority until such time that each ISP is approved. It is expected that by Summer 1998, all the necessary profiles will have been registered with ISO. By no later than 1 October 1998, the profiles controlled through this document shall be superseded by approved international profiles. This approach provides a consistent, configuration managed set of profiles that are, at first, controlled under the ISMC/GSMC, and then eventually, the ISO/JTC1. This facilitates procurement and program management issues as systems and/or software are updated for NITF 2.1/BIIF compliance.

Configuration Management of the USIGS ISP of BIIF and related ISO profiles
The following documents,

- ISO/IEC directives: Procedures for the technical work of ISO/IEC JTC1 on Information Technology, Third Edition 1995.
- ISO/IEC TR10000-1: Information technology - Framework and taxonomy of International Standardized Profiles - Part 1: General principles and documentation framework, third edition, 1995

provide information about the ISO JTC1 role in approving, registering, and maintaining configuration management of International Standards Profiles.

For the profiles of 10918-1 (JPEG), the document ISO 10918-4 defines the profile registration process.

Although ISO standards have an ISO copyright, the profiles of those standards are technically owned and controlled by the profiles' submitter. ISO does register these profiles for configuration management purposes, but does not control the technical or implementation related aspects. As is currently the case, the ISMC/GSMC shall be the controlling entity for NITFS/BIIF related profiles and standards for implementation within the DoD and IC for all components of the USIGS.

Changes to the USIGS ISP will require approval by the ISMC/GSMC, and depending on the extent of the changes, may or may not require a submission to the ISO/JTC1 authority. It needs to be noted that ISO/JTC1, as part of its approval process, determines the profiles compliance to the standard - not how it is implemented, or who implements it. Such issues will be under the realm of the ISMC/GSMC and general USIGS community.

Certification, Test and Evaluation plan

JIEO Circular 9008 establishes the NITFS Certification Test and Evaluation (CTE) Program for achieving and sustaining NITFS compliance by all fielded and developmental digital imagery systems. It describes the processes and procedures for obtaining certification of an imagery system for compliance with the NITFS. It also prescribes NITFS CTE Program policies, defines roles and responsibilities of participating organizations, and provides certification funding guidance.

Specifically, this document has ensured the community that developers of NITFS systems and applications implement the suite of standards in a similar way, addressing issues of ambiguity or confusion sometimes raised as standards are used.

The intent for the NITF 2.1 / BIIF ISP timeframe and beyond is to replace the JIEO Circular 9008 (TBR05) document with and equivalent document under the configuration management of the ISMC and NIMA.(TBR 15). The would facilitate the large number of changes envisioned in the next few years, both to the standards, technologies, and implementations; Although standards provide a level of interoperability, the Certification, Test and Evaluation plan ensure that all who read them implement them in an identical manner. The effectivity of this new document is TBR05 Further details will be provided by the Fall, 1997.

Emerging Standards and Activities

With technology evolving at an alarmingly frequent rate, the use of the Internet and World Wide Web expanding to areas unimaginable just a few years ago, and the mandate of the government to migrate to a COTS based standards environment, there is a clear need to start planning today for the standards of the future. This plan has addressed the short term future, as the USIGS community transitions from the NITFS to a suite of international standards and profiles over the 1997 - 2000 timeframe. There is an understanding, however, that the long term path for BIIF needs to be clearly defined over the next few years, so that, when programmatic and procurement windows of opportunity open, the USIGS users and elements can better support the insertion of new technologies and changing standards. This requires understanding the USIGS technical architecture today, understanding the requirements of the user in the 2002+ timeframe, and clearly understanding where the commercial market is driving information interchange standards for the 21st century.

This section briefly describes a few activities that are related to the NITFS Program, that may result in standards for inclusion into the BIIF suite for the future. Additional activities shall be introduced as this document evolves.

JPEG 2000 (E04)

JPEG 2000 is the title given to the follow-on to the currently defined JPEG standard, but which will most likely be a wavelet based solution. A key feature of this compression is that it will be based on a "modular" architecture framework. This facilitates insertion of new technologies in the future, provides for flexibility, and facilitates the potential to "swap" modules based on compression requirements (quality, rate, etc.) of individual users.

There is currently a "Call for Contributions" process, "whose goal is to: gather algorithms, components of algorithms, and architectural frameworks; and to organize algorithm components into a single architecturally based standard. An architecturally based standard has the potential of allowing the JPEG 2000 standard to evolve and integrate new algorithm components without requiring a new standards definition"[i]. Once all contributions are evaluated based on an available set of criteria, actual technical development of the standard begins.

A few additional requirements of this new algorithm include:

[i] Call for contributions for JPEG 2000 (JTC 1.29.14, 15444) : Image Coding System; International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC) Joint Technical Committee 1 /SC29/WG1 Document N505, 21 March 1997; page 4

- Improved performance (greater compression rates)
- Improved image quality
- flexibility to support different types of imagery (visible, IR, Multicomponent, etc.)
- ability to support tiling, and very small and large sized imagery

The current schedule of activities for JPEG 2000 is provided below;

Submission of algorithm contributions	Sep 97
*Submission of architecture contributions	Oct 97
Second experimental results and convergence	Mar 98
WD to Committee Draft (CD)	Jul 98
CD to final CD	Mar 99
Submit CD for Draft International Standard (DIS)	Nov 99
DIS submitted for International Standard (IS)	Mar 00
IS	Nov 00

Profile development of the JPEG 2000 standard could potentially begin once it is accepted as a Draft International Standard (DIS). As details of the document are available, and schedules are clearly defined, this strategic plan will provide information regarding implementation into the NITFS/BIIF suite of standards (TBR 13)

Multi-Component JPEG (E03)

The purpose of this multicomponent JPEG standard, under the leadership of the ISO JTC1 /SC29/WG1 organization, is to provide a standard means of compressing and decompressing multiple-component, continuous tone images, in such a way that the reconstructed output has minimal image quality loss with respect to the original image. This standard would be applicable to those users who have imagery that does not subscribe well to the standard colour compression techniques commonly used with the current JPEG, such as multispectral imagery, medical imagery (MRI, CAT scan), and colour imagery.

A primary goal for this algorithm is to maintain compatibility with the procedures defined in IS 10918-1 in order to maintain some level of backward compatibility to the current JPEG standard. There is an additional objective of developing it such that it will fit into the JPEG 2000 architecture framework, and hence, avoid the potential problem of having two standards that can potentially support Multispectral imagery

Below is the schedule for this work item;

- Submission of algorithm contributions Nov 96
- Development of WD Nov 97
- Development of CD Mar 98
- Development of DIS Jul 98
- IS Nov 98

The intention is, that once the Multicomponent JPEG Standard is approved as a DIS, a profile will be written such that it can be implemented by NITF/BIIF systems (TBR 12).. Details of this will be provided in this strategic plan as they are made available.

Complex Data Compression

There are several ongoing activities in the area of complex SAR data compression that may potentially impact the NITFS/BIIF community. These involve the definition of complex data compression standard. Although not a work item in the international standards groups, the DoD/IC are actively addressing this requirement. It is however, very early in the development process, and the technology is not yet mature enough to provide additional information.

Emerging container technologies

Activities in the ISO, Object Management Group(OMG) and the Open GIS Consortium (OGC) are going to force the NITF/BIIF community to look to a new paradigm for how information (not just imagery, but video, audio, graphics, and any other data types) will be exchanged within the USIGS of the future. The evolution to distributed computing environments and new container technologies is focusing on object oriented approaches, such as the Common Request Broker Architecture (CORBA) from the OMG, Java from SUN Microsystems, and Active X from Microsoft. This is an emerging paradigm that will support the data interchange requirements, and COTS technologies of the 21st Century. The DoD and Intelligence community are actively pursuing activities to identify how the we can migrate from the current paradigm (as is now implemented by NITF/BIIF) to the paradigm that the international standards organizations and commercial consortiums are quickly heading towards.

Motion imagery/Video related standards activities

There is a great deal of interest in disseminating motion video imagery clips in the NSIF/BIIF format. Work on this requirement will commence in the Summer 1997 timeframe. It is expected that once this capability is identified, it will be inserted into the USIGS ISP of BIIF as a potential option. No further details are available at this time.

Convergence of the Raster Product Format (RPF) and NITF 2.1/BIIF ISP (E05)

Activities are currently underway in defining a strategy on when and how the Raster Product Format can be harmonized with the NITF 2.1/BIIF ISP. Details of this strategy, as well a assessments of impacts to existing and future production systems activities will be provided in the late summer 1997 timeframe. , The three NIMA generated products that are impacted by this harmonization are:

- Compressed ARC Digitized Raster Graphics (CADRG)
- Controlled Image Base (CIB)
- Digital Point Positioning Data Base (DPPDB)

The Spatial Data Transfer Standard (SDTS)

TBR06

ANNEX A - USIGS Profile of ISO 12087-5, BIIF

A sample of the International Standardized Profile of ISO/IEC 12087-5, BIIF, to be used by the NITFS community, is defined in an annex to the DIS BIIF Document. Once the details of the ISP are finalized, it will be submitted to the ISO JTC1 Registration Authority for approval. At the same time, it shall be included in whole, in this annex to this strategic plan. Once the ISO registers the ISP (TBR07), it shall become the authoritative document for development and procurement purposes, and shall supersede the contents of this Annex.

ANNEX B - USIGS Profile of 10918-1, Lossy JPEG

JPEG Part 4, ISO/IEC 10918-4 (DIS), will contain, as an example, the profile of the baseline Lossy JPEG algorithm implemented by the NITFS community. Once the JPEG part-4 document becomes an approved DIS, a profile for the USIGS implementation of ISOI/IEC JPEG, as defined in ISO/IEC 10918-1, will be submitted to the AFNOR for approval. At the same time, this profile shall be included, in whole, within this annex. When the ISO registers the profile (TBR08), it shall become the authoritative document for development and procurement purposes, and shall supersede the contents of this Annex.

ANNEX -C - USIGS Profile of 10918-1, Lossless JPEG

JPEG Part 4, ISO/IEC 10918-4 (DIS), contains, as an example, the profile of the Lossless JPEG algorithm to be implemented by the NITFS community. Once the JPEG part-4 document becomes an approved DIS, a profile for the USIGS implementation of ISOI/IEC JPEG, as defined in ISO/IEC 10918-1, will be submitted to the AFNOR for approval. At the same time, this profile shall be included, in whole, within this annex. When the ISO registers the profile (TBR09), it shall become the authoritative document for development and procurement purposes, and shall supersede the contents of this Annex.

C.1.1. Normative Description

C.1.1.1 Scope

This document establishes the requirements to be met by National Imagery Transmission Format Standard (NITFS) compliant systems when image data is compressed using the JPEG lossless image compression algorithm as described in ISO/IEC 10918-1, "Digital Compression and Coding of Continuous-tone Still Images."

C.1.1.2 Content

This document provides a profile of ISO/IEC 10918-1 for the NITFS compression algorithm designated by the code C5 in the Image Compression field of the NITF file image subheader for 2 to 16-bit gray scale imagery and 24-bit color imagery.

C.5.1.3 Applicable Documents

C.5.1.3.1 Government documents

The following standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplements thereto, cited in the solicitation.

C.5.1.3.1.1 Specifications, standards, and handbooks

FEDERAL STANDARDS

FED-STD-1037B - Telecommunications: Glossary of Telecommunication Terms, 3 June 1991.

(Copies of the referenced Federal Standards are available from General Services Administration, GSA Specification Section, Room 6654, 7th and D Streets, S.W. Washington, D.C. 20407; telephone (202) 472-2205).

MILITARY STANDARDS

MIL-STD-2500A National Imagery Transmission Format (Version 2.0) for the National Imagery Transmission Format Standard, 18 June 1993.

MILITARY HANDBOOKS

MIL-HDBK-1300A Military Handbook National Imagery Transmission Format Standard, 18 June 1993.

(Copies may be obtained from TASC, 55 Walkers Brook Drive, Reading, MA 01867-3297, Attn: NTB Secretary; telephone (617) 942-2000 x2932, fax (617) 942-7100).

C.5.1.3.1.2 Other government documents, drawings, and publications

The following other Government documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation.

DISA/JIEO Circular 9008	National Imagery Transmission Format Standard Certification Test and Evaluation Program Plan, 30 June 1993.

C.5.1.3.2 International and national publications

The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are Department of Defense (DoD) adopted are those listed in the issue of the DODISS cited in the solicitation.

C.5.1.3.2.1 International standards

ISO ISO/IEC 10918-1/ CCITT	Digital Compression and Coding of Continuous-tone Recommendation T.81 Still Images. Part I: Requirements and Guidelines, September, 1992.
ISO ISO/IEC 10918-3/ CCITT	Digital Compression and Coding of Continuous- tone Recommendation T.84 Still Images: Extensions, November, 1995.

(Copies may be obtained from X3 Secretariat, Computer and Business Equipment Manufacturers Association, 311 First Street NW, Suite 500, Washington, DC 20001-2178)

C.5.1.3.2.2 National standards

None.

C.5.1.3.3 Order of precedence

In the event of a conflict between the text of this profile and the references cited herein, the text of this profile shall take precedence. Nothing in this profile, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

C.5.1.4Definitions, Abbreviations, and Symbols

The following definitions are applicable for the purpose of this profile. In addition, terms used in this profile and defined in the FED-STD-1037B shall use the FED-STD-1037B definition unless noted.

C.5.1.4.1 Definitions

See ISO/IEC 10918-1 and ISO/IEC 10918-3 for definition of terms used in this profile.

C.5.1.4.2 Abbreviations

JIEO Joint Interoperability and Engineering Organization (formerly JTC^{3}A)

NITF National Imagery Transmission Format

NITFS National Imagery Transmission Format Standard

RGB Red, Green, Blue

See ISO/IEC 10918-1 and ISO/IEC 10918-3 for other abbreviations used in this profile.

C.5.1.4.3 Symbols

See ISO/IEC 10918-1 and ISO/IEC 10918-3 for definition of symbols used in this profile.

C.5.1.5` General Requirements

C.5.1.5.1 Interoperability

The profile specified in this document is intended to enable the interchange in the NITFS format, of 2 to16 bit gray scale imagery and 24 bit color imagery. ISO/IEC 10918-1 represents a collection of lossy and lossless compression techniques, a subset of the lossless procedures are used in generation of the compressed image data stream shown. Unless expressly forbidden in this profile, any procedure in ISO/IEC 10918-1 applicable to lossless encoding may be applied. Any optional processes in ISO/IEC 10918-1 required by this profile will be detailed.

C.5.1.5.2 Encoders

Encoders shall output to the image data field of the NITF file a full interchange format that includes the compressed image data and all table specifications used in the encoding process.

C.5.1.5.3 Decoders

All decoders shall interpret full interchange format. Abbreviated interchange format decoders are not a requirement of this profile.

C.5.1.6Markers and Tags

The following tables specify the markers and tag usage from ISO/IEC 10918-1 and ISO/IEC 10918-3 applicable to the NITFS Lossless JPEG profile.

Table C.5.1 - Marker usage
(ISO/IEC 10918-1, JPEG part 1)

Symbol	Description	Parameters	Req.	Cap.	Exc.
Start Of Frame markers, non-differential, Huffman coding					
SOF_0	Baseline DCT	Table 4			**X**
SOF_1	Extended sequential DCT				**X**
SOF_2	Progressive DCT				**X**
SOF_3	Lossless (sequential)		**X**		
Start Of Frame markers, differential, Huffman coding					
SOF_5	Differential sequential DCT				**X**
SOF_6	Differential progressive DCT				**X**
SOF_7	Differential lossless (sequential)				**X**
Start Of Frame markers, non-differential, arithmetic coding					
SOF_9	Extended sequential DCT				**X**
SOF_{10}	Progressive DCT				**X**
SOF_{11}	Lossless (sequential)				**X**
Start Of Frame markers, differential, arithmetic coding					
SOF_{13}	Differential sequential DCT				**X**
SOF_{14}	Differential progressive DCT				**X**
SOF_{15}	Differential lossless (sequential)				**X**
Huffman table specification					
DHT	Define Huffman table(s)	Table 5		**X**	
Arithmetic coding conditioning specification					
DAC	Define arithmetic coding conditioning(s)	Table 6			**X**
Restart interval termination					
RST_m	Restart with modulo 8 count “m”		**X**		
Other markers					
SOI	Start of image		**X**		
EOI	End of image		**X**		
SOS	Start of scan	Table 7	**X**		
DQT	Define quantization table(s)	Table 8			**X**
DNL	Define number of lines	Table 12			**X**
DRI	Define restart interval	Table 9	**X**		
DHP	Define hierarchical progression	see ISO/IEC 10918-1			**X**
EXP	Expand reference component(s)	Table 13			**X**
APP_n	Reserved for application segments	Table 11		**X**	

COM	Comment	Table 10		**X**	

Table C.5.2 - Marker usage
(ISO/IEC 10918-3, JPEG part 3)

Symbol	Description	Parameters	Req.	Cap.	Exc.
Version 1 Extensions					
VER	Version	Table 15			**X**
DTI	Define tiled image	Table 20			**X**
DTT	Define tile	Table 21			**X**
SRF	Selectively refined frame	Table 18			**X**
SRS	Selectively refined scan	Table 19			**X**
DCR	Define component registration	Table 22			**X**
DQS	Define quantizer scale selection	Table 23			**X**

Table C.5.3 - SPIFF tags usage
(ISO/IEC 10918-3, JPEG part 3)

SPIFF tags	Parameters	Req.	Cap.	Exc.
SPIFF header	Table 14			**X**
Transfer characteristics	Table 24			**X**
Component registration	Table 25			**X**
Image orientation	Table 26			**X**
Thumbnail	Table 27			**X**
Image title	Table 28			**X**
Image description	Table 29			**X**
Time stamp	Table 30			**X**
Version identifier	Table 31			**X**
Creator identification	Table 32			**X**
Protection indicator	Table 33			**X**
Copyright information	Table 34			**X**
Contact information	Table 35			**X**
Tile index	Table 36			**X**
Scan index	Table 37			**X**
Set reference	Table 38			**X**

C.5.1.7Marker and Tag Parameterization

The following tables specify the values and range of values allowed for all required and capable markers indicated in section 1.6. For clarity, whenever a parameterization is between one of a few choices that significantly alters a table's size or structure, multiple versions of that table are included, one for each parameterization. If a given table is not applicable to this profile, it will be indicated by "N/A" in its parameter specifications.

This profile provides for the lossless encoding of 2-16 bit gray scale and 24 bit RGB color imagery. Many tables therefore have two parameterizations depending on imagery type. In the following tables the parameter specifications for gray scale imagery are given first, followed by those for RGB color imagery. The parameters associated with a given image type cannot be mixed with those of another image type. For example, if we are using RGB imagery, then in Table A.4, Lf = 17 and P = 8. These are the only allowed combination of parameters. If only one parameter specification is given for any parameter in a table, it applies to both image types.

Table C.5.4 - Frame header (SOF)
(See ISO/IEC 10918-1 Table C.2)

Parameter	Size (bits)	Values				Profile Parameter Specifications (Gray, RGB)
		Sequential DCT		Progressive DCT	Lossless	
		Baseline	Extended			
Lf	16	8 + 3 ´ Nf				11, 17
P	8	8	8, 12	8, 12	2-16	2-16, 8
Y	16	$0 \le Y \le 2^{16} - 1$				$1 \le Y \le 2^{16} - 1$
X	16	$1 \le X \le 2^{16} - 1$				$1 \le X \le 2^{16} - 1$
Nf	8	1-255	1-255	1-4	1-255	1, 3
C_i	8	0-255				0, 0-2
H_i	4	1-4				1
V_i	4	1-4				1
Tq_i	8	0-3	0-3	0-3	0	0

Table C.5.5 - Huffman table specification (DHT)
(See ISO/IEC 10918-1 Table C.5)

Parameter	Size (bits)	Values				Profile Parameter Specifications (Gray, RGB)
		Sequential DCT		Progressive DCT	Lossless	
		Baseline	Extended			
Lh	16	$2 + \sum_{t=1}^{n} (17 + m_t)$				22-36, [28,29, 54,56,80,83] see Table 40
Tc	4	0,1			0	0
Th	4	0,1	0-3			0, 0-2
L_i	8	0-255				0-255
$V_{i,j}$	8	0-255				0-255

Table C.5.6 - Arithmetic coding conditioning table-specification (DAC)
(See ISO/IEC 10918-1 Table C.6)

Parameter	Size (bits)	Values				Profile Parameter Specifications
		Sequential DCT		Progressive DCT	Lossless	
		Baseline	Extended			
La	16	Undefined	2 + 2 x n			N/A
Tc	4	Undefined	0,1		0	N/A
Tb	4	Undefined	0-3			N/A
Cs	8	Undefined	0-255 (Tc = 0), 1-63 (Tc = 1)		0-255	N/A

Table C.5.7 - Scan header (SOS)
(See ISO/IEC 10918-1 Table C.3)

Parameter	Size (bits)	Values				Profile Parameter Specifications (Gray, RGB)
		Sequential DCT		Progressive DCT	Lossless	
		Baseline	Extended			
Ls	16	6 + 2 ´ Ns				8, 12
Ns	8	1-4				1, 3
Cs_j	8	0-255[a)]				0, 0-2
Td_j	4	0-1	0-3	0-3	0-3	0, 0-2
Ta_j	4	0-1	0-3	0-3	0	0
Ss	8	0	0	0-63	1-7[b)]	1-7
Se	8	63	63	Ss-63[c)]	0	0
Ah	4	0	0	0-13	0	0
Al	4	0	0	0-13	0-15	0-15

a) Cs_j shall be a member of the set of C_i specified in the frame header.

b) 0 for lossless differential frames in the hierarchical mode (see C.3 of ISO/IEC 10918-1)

c) 0 if Ss equals zero.

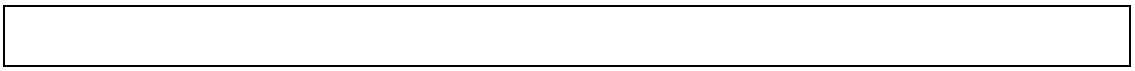

Table C.5.8 - Quantization table-specification (DQT)
(See ISO/IEC 10918-1 Table C.4)

Parameter	Size (bits)	Values				Profile Parameter Specifications
		Sequential DCT		Progressive DCT	Lossless	
		Baseline	Extended			
Lq	16	$2+\sum_{t=1}^{n}(65+64\times P_q(t))$			Undefined	N/A
Pq	4	0	0,1	0,1	Undefined	N/A
Tq	4	0-3			Undefined	N/A
Qk	8,16	1-255, $1 \le Qk \le 2^{16} - 1$			Undefined	N/A

Table C.5.9 - Define restart interval segment (DRI)
(See ISO/IEC 10918-1 Table C.7)

Parameter	Size (bits)	Values				Profile Parameter Specifications
		Sequential DCT		Progressive DCT	Lossless	
		Baseline	Extended			
Lr	16	4				4
Ri	16	$0 \le Ri \le 2^{16} - 1$			n x MCUR	1-8

Table C.5.10 - Comment segment (COM)
(See ISO/IEC 10918-1 Table C.8)

Parameter	Size (bits)	Values				Profile Parameter Specifications
		Sequential DCT		Progressive DCT	Lossless	
		Baseline	Extended			
Lc	16	$2 \le Lc \le 2^{16} - 1$				$2 \le Lc \le 2^{16} - 1$
Cm_i	8	0-255				0-255

Table C.5.11 - Application data segment (APPn)
(See ISO/IEC 10918-1 Table C.9)

Parameter	Size (bits)	Values				Profile Parameter Specifications
		Sequential DCT		Progressive DCT	Lossless	
		Baseline	Extended			
Lp	16	$2 \le Lp \le 2^{16} - 1$				$2 \le Lp \le 2^{16} - 1$
Ap_i	8	0-255				0-255

Table C.5.12 - Define number of lines segment (DNL))
(See ISO/IEC 10918-1 Table C.10)

Parameter	Size (bits)	Values				Profile Parameter Specifications
		Sequential DCT		Progressive DCT	Lossless	
		Baseline	Extended			
Ld	16	4				N/A
NL	16	$1 \le NL \le 2^{16} - 1$ a)				N/A

a) The value specified shall be consistent with the number of lines coded at the point where the DNL segment terminates the compressed data segment.

Table C.5.13 - Expand segment (EXP))
(See ISO/IEC 10918-1 Table C.11)

Parameter	Size (bits)	Values			Profile Parameter Specifications
		Sequential DCT	Progressive DCT	Lossless	
		Extended			
Le	16	3			N/A
Eh	4	0, 1			N/A
Ev	4	0, 1			N/A

The remaining tables of this section deal with extensions and file formats in ISO/IEC 10918-3. This profile does not make use of these features and they are therefore not applicable. No markers or tags associated with ISO/IEC 10918-3 will appear in a file or data stream compliant to this profile.

Table C.5.14 - SPIFF file header)
(See ISO/IEC 10918-3 Table F.1)

parameter	type . size	values	Profile Parameter Specifications
MN	I.32	X'FFD8FFE8'	N/A
HLEN	I.16	32	N/A
IDENT	S.6	X'535049464600'	N/A
VERS	I.16	X'0100'	N/A
P	I.8	0 - 4	N/A
NC	I.8	1 - 255	N/A
HEIGHT	I.32	$1 \leq \text{HEIGHT} \leq 2^{32} - 1$	N/A
WIDTH	I.32	$1 \leq \text{WIDTH} \leq 2^{32} - 1$	N/A
S	I.8	0 - 15	N/A
BPS	I.8	1,2,4,8,12,16	N/A
C	I.8	0 - 5	N/A
R	I.8	0 - 2	N/A
VRES	F / I.32	$1 \leq \text{VRES} \leq 2^{32} - 1$	N/A
HRES	F / I.32	$1 \leq \text{HRES} \leq 2^{32} - 1$	N/A

Table 15 - C.5.Version marker segment (VER)
(See ISO/IEC 10918-3 Table C.3)

		Values				Profile Parameter Specifications
		Sequential DCT		Progressive DCT	Lossless	
Parameter	Size (bits)	Baseline	Extended			
Lv	16	5, **V** = 0 6, **V** = 1				N/A
V	8	0, 1				N/A
Rev	8	0				N/A
CAPi	8	CAP_0, version 0, see Table **16**				N/A

	8	CAP_1, version 1, see Table **17**	

Table C.5.16 - Capability indicator byte for Version 0 (JPEG part 1)

Coding Process (ISO/IEC 10918-1)			CAP_0 Value	Req.	Cap.	Exc.
Baseline sequential			0000 0000	N/A	N/A	N/A
Extended sequential,	Huffman,	8-bits	0000 0001	N/A	N/A	N/A
Extended sequential	arithmetic,	8-bits	0000 0011	N/A	N/A	N/A
Extended sequential	Huffman,	12-bits	0000 0101	N/A	N/A	N/A
Extended sequential	arithmetic,	12-bits	0000 0111	N/A	N/A	N/A
Spectral selection	Huffman,	8-bits	0001 0001	N/A	N/A	N/A
Spectral selection	arithmetic,	8-bits	0001 0011	N/A	N/A	N/A
Full progression	Huffman,	8-bits	0001 1001	N/A	N/A	N/A
Full progression	arithmetic,	8-bits	0001 1011	N/A	N/A	N/A
Spectral selection	Huffman,	12-bits	0001 0101	N/A	N/A	N/A
Spectral selection	arithmetic,	12-bits	0001 0111	N/A	N/A	N/A
Full progression	Huffman,	12-bits	0001 1101	N/A	N/A	N/A
Full progression	arithmetic,	12-bits	0001 1111	N/A	N/A	N/A
Lossless	Huffman		0010 0001	N/A	N/A	N/A
Lossless	arithmetic		0010 0011	N/A	N/A	N/A
Hierarchical, sequential	Huffman,	8-bits	0100 0001	N/A	N/A	N/A
Hierarchical, sequential	arithmetic,	8-bits	0100 0011	N/A	N/A	N/A
Hierarchical, sequential	Huffman,	12-bits	0100 0101	N/A	N/A	N/A
Hierarchical, sequential	arithmetic,	12-bits	0100 0111	N/A	N/A	N/A
Hierarchical, Spectral selection	Huffman,	8-bits	0101 0001	N/A	N/A	N/A
Hierarchical, Spectral selection	arithmetic,	8-bits	0101 0011	N/A	N/A	N/A
Hierarchical, Full progression	Huffman,	8-bits	0101 1001	N/A	N/A	N/A
Hierarchical, Full progression	arithmetic,	8-bits	0101 1011	N/A	N/A	N/A
Hierarchical, Spectral selection	Huffman,	12-bits	0101 0101	N/A	N/A	N/A
Hierarchical, Spectral selection	arithmetic,	12-bits	0101 0111	N/A	N/A	N/A
Hierarchical, Full progression	Huffman,	12-bits	0101 1101	N/A	N/A	N/A
Hierarchical, Full progression	arithmetic,	12-bits	0101 1111	N/A	N/A	N/A
Hierarchical, Lossless	Huffman		0110 0001	N/A	N/A	N/A
Hierarchical, Lossless	arithmetic		0110 0011	N/A	N/A	N/A

Table C.5.17 - Capability indicator byte for Version 1 (JPEG part 3)

Note - ‘x’ indicates ‘don’t care’

Capability (ISO/IEC 10918-3)	Bit positions	Req.	Cap.	Exc.
10 < blocks per MCU < = 20	0xxx xxx1	N/A	N/A	N/A
Variable quantization	0xxx xx1x	N/A	N/A	N/A
Hierarchical selective refinement	0xxx x1xx	N/A	N/A	N/A
Progressive selective refinement	0xxx 1xxx	N/A	N/A	N/A
Component selective refinement	0xx1 xxxx	N/A	N/A	N/A
Simple tiling	001x xxxx	N/A	N/A	N/A
Pyramidal tiling	010x xxxx	N/A	N/A	N/A
Composite tiling	011x xxxx	N/A	N/A	N/A

Table C.5.18 - Selectively refined frame (SRF)
(See ISO/IEC 10918-3 Table C.6)

Parameter	Size (bits)	Values	Profile Parameter Specifications
Lrf	16	6	N/A
Ovf	16	$0 \leq Ovf \leq 2^{16} - 1$	N/A
Ohf	16	$0 \leq Ohf \leq 2^{16} - 1$	N/A

Table C.5.19 - Selectively refined scan (SRS)
(See ISO/IEC 10918-3 Table C.7)

Parameter	Size (bits)	Values	Profile Parameter Specifications
Lrs	16	10	N/A
Ovs	16	$0 \leq Ovs \leq 2^{16} - 1$	N/A
Ohs	16	$0 \leq Ohs \leq 2^{16} - 1$	N/A
Svs	16	$1 \leq Svs \leq 2^{16} - 1$	N/A
Shs	16	$1 \leq Shs \leq 2^{16} - 1$	N/A

Table C.5.20 - Define tiled image (DTI)
(See ISO/IEC 10918-3 Table C.8)

Parameter	Size (bits)	Values	Profile Parameter Specifications
Lti	16	15	N/A
TT	8	0 = simple, 1 = pyramidal, 2 = composite	N/A
TIvs	16	1 for simple and pyramidal tiling $1 \leq TIvs \leq 2^{16}-1$ for composite tiling	N/A
TIhs	16	1 for simple and pyramidal tiling $1 \leq TIhs \leq 2^{16}-1$ for composite tiling	N/A
RGvs	32	$1 \leq RGvs \leq 2^{32} - 1$	N/A
RGhs	32	$1 \leq RGhs \leq 2^{32} - 1$	N/A

Table C.5.21 - Define tile (DTT)
(See ISO/IEC 10918-3 Table C.9)

Parameter	Size (bits)	Values	Profile Parameter Specifications
Ltf	16	18	N/A
TFvs	32	$1 \leq TFvs \leq 2^{32} - 1$	N/A
TFhs	32	$1 \leq TFhs \leq 2^{32} - 1$	N/A
TFvo	32	$0 \leq TFvo \leq 2^{32} - 1$	N/A
TFho	32	$0 \leq TFho \leq 2^{32} - 1$	N/A

Table C.5.22 - Define component registration (DCR)
(See ISO/IEC 10918-3 Table C.10)

Parameter	Size (bits)	Values	Profile Parameter Specifications
Lcr	16	4	N/A
Ci	8	$0 \leq Ci \leq 255$	N/A
CRvo	4	$0 \leq CRvo \leq 8$	N/A
CRho	4	$0 \leq CRho \leq 8$	N/A

Table C.5.23 - Define quantizer scale selection (DQS)
(See ISO/IEC 10918-3 Table C.11)

Parameter	Size (bits)	Values	Profile Parameter Specifications
Lqs	16	3	N/A
Tc	8	Tc = 0 indicates a linear table Tc = 1 indicates a non-linear table	N/A

Table C.5.24 - Transfer characteristics
(See ISO/IEC 10918-3 Table F.6)

Transfer characteristics			Tag value: X'00000002'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	TRANCHAR	I.8	1-8	N/A
1	RESERVED	C.3	0	N/A

Table C.5.25 - Component registration
(See ISO/IEC 10918-3 Table F.7)

Component registration			Tag value: X'00000003'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	$CROFFSET_0$	I.8	0 - 255	N/A
1	$CROFFSET_1$	I.8	0 - 255	N/A
2	…			

Table C.5.26 - Image orientation
(See ISO/IEC 10918-3 Table F.8)

Image orientation			Tag value: X'00000004'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	IMGOR	I.8	0 - 3	N/A
1	IMGFLIP	I.8	0, 1	N/A
2	RESERVED	C.2	0	N/A

Table C.5.27 - Thumbnail image specification
(See ISO/IEC 10918-3 Table F.9)

Thumbnail image specification			Tag value: X'00000005'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	TNDATA	I.32	Any	N/A
4	TNHEIGHT	I.16	$1 \leq TNHEIGHT \leq 2^{16} - 1$	N/A
6	TNWIDTH	I.16	$1 \leq TNWIDTH \leq 2^{16} - 1$	N/A
8	TNS	I.8	0 - 14	N/A
9	TNBPS	I.8	1,2,4,8,12,16	N/A
10	TNC	I.8	0 - 5	N/A
11	RESERVED	C.1	0	N/A
12	…			

Table C.5.28 - Image title
(See ISO/IEC 10918-3 Table F.10)

Image title			Tag value: X'00000006'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	TITLELOC	I.32	0 or in range from EOI marker offset to 2^{32} - 1	N/A
4	CHARSET	I.8	1 to N, where N is largest existing ISO/IEC 8859-N, 254, 255	N/A
5	…			

Table C.5.29 - Image description
(See ISO/IEC 10918-3 Table F.11)

Image description			Tag value: X'00000007'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	DESCLOC	I.32	0 or in range from EOI marker offset to 2^{32} - 1	N/A
4	CHARSET	I.8	1 to N, where N is largest existing ISO/IEC 8859-N, 254, 255	N/A
5	…			

Table C.5.30 - Time stamp
(See ISO/IEC 10918-3 Table F.12)

Time Stamp			Tag value: X'00000008'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	DATE	S.10	ISO 8601 format date	N/A
10	TIME	S.13	ISO 8601 format time	N/A
23	RESERVED	C.1	0 (reserved)	

Table C.5.31 - Version identifier
(See ISO/IEC 10918-3 Table F.13)

Version identifier			Tag value: X'00000009'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	VERSNLOC	I.32	0 or in range from EOI marker offset to 2^{32} - 1	N/A
4	CHARSET	I.8	1 to N, where N is largest existing ISO/IEC 8859-N, 254, 255	N/A
5	…			

Table C.5.32 - Creator identification
(See ISO/IEC 10918-3 Table F.14)

Creator Identification			Tag value: X'0000000A'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	CREATLOC	I.32	0 or in range from EOI marker offset to 2^{32} -1	N/A
4	CHARSET	I.8	1 to N, where N is largest existing ISO/IEC 8859-N, 254, 255	N/A
5	…			

Table C.5.33 - Protection indicator
(See ISO/IEC 10918-3 Table F.15)

Protection Indicator			Tag value: X'0000000B'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	LEVAUT	I.8	0-3	N/A
1	COPYRID	I.8	0-255	N/A
2	RESERVED	C.2	0 (reserved)	

Table C.5.34 - Copyright information
(See ISO/IEC 10918-3 Table F.16)

Copyright Information			Tag value: X'0000000C'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	COPYRLOC	I.32	0 or in range from EOI marker offset to 2^{32} - 1	N/A
4	CHARSET	I.8	1 to N, where N is largest existing ISO/IEC 8859-N, 254, 255	N/A
5	…			

Table C.5.35 - Contact information
(See ISO/IEC 10918-3 Table F.17)

Contact Information			Tag value: X'0000000D'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	REGCON	I.16	$1 \leq$ REGCON $\leq 2^{16} - 1$, interpreted as ISO 3166 numeric country code. A value of X'0000' indicates an international organisation.	N/A
2	REGAUT	I.16	$0 \leq$ REGAUT $\leq 2^{16} - 1$	N/A
4	REGID	I.32	$0 \leq$ REGID $\leq 2^{32} - 1$	N/A
8	CONTLOC	I.32	0 or in range from EOI marker offset to 2^{32} - 1	N/A
12	CHARSET	I.8	1 to N, where N is largest existing ISO/IEC 8859-N, 254, 255	N/A
13	…			

Table C.5.36 - Tile index
(See ISO/IEC 10918-3 Table F.18)

Tile Index			Tag value: X'0000000E'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	DTTINDX	I.32	0 or in range from EOI marker offset to $2^{32} - 1$	N/A
4	NUMDTT	I.32	$0 \leq$ NUMDTT $\leq 2^{32} - 1$	N/A

Table C.5.37 - Scan index
(See ISO/IEC 10918-3 Table F.19)

Scan Index			Tag value: X'0000000F'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	SCANLIST	I.32	0 or in range from EOI marker offset to $2^{32} - 1$	N/A
4	NUMSCAN	I.32	$0 \leq$ NUMSCAN $\leq 2^{32} - 1$	N/A

Table C.5.38 - Set reference
(See ISO/IEC 10918-3 Table F.20)

Set reference			Tag value: X'00000010'	Profile Parameter Specifications
offset	parameter	type . size	values	
0	REFNO1	I.32	$0 \leq$ REFNO1 $\leq 2^{32} - 1$	N/A
4	REFNO2	I.32	$0 \leq$ REFNO2 $\leq 2^{32} - 1$	N/A
8	REFNO3	I.32	$0 \leq$ REFNO3 $\leq 2^{32} - 1$	N/A

C.5.1.8Colour Space

The JPEG processes in ISO/IEC 10918-1 are color blind. In this profile two types of imagery are specified, 2 to 16 bit gray scale and 24 bit RGB color. The IREP and IREPBAND fields (defined in MIL-STD-2500A) within the NITF image subheader are used to identify the color space for each component present in the image; these components may be interleaved or not. When the components are interleaved, the interleave order shall be R, G, B with each MCU containing three data units, one from each component. In the non-interleaved case, each MCU consists of just one data unit from any of the components.

C.5.1.9APPn Marker Usage

C.5.1.9.1 NITF APP_6 application data segment

NITF requires the use of an NITF APP_6 application data segment. This APP_6 application data segment may be identified by the null-terminated (0x00) string "NITF" immediately following the length parameter L_p (see Table C.5.39). The NITF application data segment shall immediately follow the first SOI marker in the Image Data Field. The NITF application data segment contains information which is needed by an interpreter but not supported by the ISO/CCITT JPEG format. Most of this information is also present in some fields of the NITF image sub-header (COMRAT, IREPBAND, NBPP, etc.). For a description of the fields in the APP6 marker segment see MIL-STD 2500A.

Since no default Huffman tables are defined in this standard, the tables to be used by the decoder must always be present in the compressed stream. The Huffman table specification can optionally be embedded in the NITF application data segment (shaded area in Table C.5.39). Multiple Huffman tables may be specified (up to three) in the application data segment. In this case the table(s) will provide "default" table specification(s) for subsequent image blocks (for an explanation of image blocks see MIL-STD 2500A). The DHT marker segment need not be embedded in the APP_6 data segment and may appear in the appropriate places in the bitstream as specified in IS 10918-1.

Only DHT marker segments embedded in APP_6 will be considered defaults. Huffman tables defined outside of APP_6 are considered "custom" tables. NITFS does not allow the carryover of custom Huffman tables from one image block to the next. Custom tables must be included in each block where default tables are not used. Any Huffman table defined with a previously used table identifier shall replace the previously defined table. The format is shown in Table 39 with the Huffman table segment variable fields specified in Table C.5.40 for the different image types. If no DHT marker segment is embedded in the APP_6 data segment, the length parameter, L_p, shall be equal to 20.

A second variation of the APP_6 application data segment is given in Table 41. Here the length of the APP6 data segment equals that of the NITF lossy JPEG APP_6 data segment as defined in paragraph C.4.1.4. The length parameter, L_p, is always equal to 25. Zero (NULL) byte padding is used to achieve this length. This variation of the NITF profile is identical to that described above with the exception that Huffman tables (DHT marker segment) may not appear in the APP_6 data segment. The form of this second type of APP6 application data segment is given in Table C.5.41.

Table C.5.39 - NITF APP_6 application data segment

Offset	Field Value	Field Name	length (bytes)	comments	
0	0xFFE6	APP_6	2	NITF application data marker.	
2	see Table 40	L_p	2	Segment length (2 + length of application data)	
4	0x4E49 0x5446 0x00	Identifier	5	Null terminated string: "NITF"	
9	0x0200	Version	2	Version number. The most significant byte is used for major revisions, the least significant byte for minor revisions. Version 2.00 is the current revision level.	
11	0x42, 0x50 or 0x53	IMODE	1	Image Format. Three values are defined at this time. 'B' - IMODE = B 'P' - IMODE = P 'S' - IMODE = S	
12	1-9999	H	2	Number of image blocks per row.	
14	1-9999	V	2	Number of image blocks per column.	
16	0-1	Image Color	1	Original image color representation. Two values are defined at this time. 0 - monochrome 1 - RGB	
17	1-16	Image Bits	1	Original image sample precision.	
18	0-99	Image Class	1	Image data class (0-99). One value is defined at this time 0 - general purpose	
19	1 - 29	JPEG Process	1	JPEG coding process. The values of this field are defined to be consistent with ISO IS 10918-2. 14 - Sequential lossless	
20	0xFFC4	DHT	2	Define Huffman table marker	
22	see Table 40	L_h	2	Length of parameters	
24	see Table 40	T_cT_h	1	T_c: Table class = 0 T_h: Huffman table identifier (0-2).	first table
25	0-255	L_i	16	Number of codes of each length (BITS array)	first table

41	0-255	$V_{i,j}$	see Table 40	Symbols (HUFFVAL array)	first table
		T_cT_h	1	T_c: Table class = 0 T_h: Huffman table identifier (0-2).	last table
	0-255	L_i	16	Number of codes of each length (BITS array)	last table
	0-255	$V_{i,j}$	see Table 40	Symbols (HUFFVAL array)	last table
	0	Flags	2	Reserved for future use.	

Table C.5.40 - APP6 and DHT lengths

Field Name	N-bit gray scale N ∈ [2, 3, ..., 15]	16-bit gray scale	RGB color (N = 8)	
Lp	20, 22 + L_h	20, 58	20, 22 + L_h	
L_h	$19 + m_t$	36	$2 + \sum_{t=1}^{n}(17 + m_t)$	
T_cT_h	0x00	0x00	0x0X, X ∈ [0, 1, 2]	
# of $V_{i,j}$ (m_t)	$m_t = N + 1$	17	$m_t = 9$	Predictors 1-3 and 7
	$m_t = N + 2$	17	$m_t = 10$	Predictors 4-6

Table C.5.41 - NITF APP_6 application data segment (second type)

Offset	Field Value	Field Name	length (bytes)	comments
0	0xFFE6	APP_6	2	NITF application data marker.
2	see Table 40	L_p	2	Segment length (2 + length of application data)
4	0x4E49 0x5446 0x00	Identifier	5	Null terminated string: "NITF"
9	0x0200	Version	2	Version number. The most significant byte is used for major revisions, the least significant byte for minor revisions. Version 2.00 is the current revision level.
11	0x42, 0x50 or 0x53	IMODE	1	Image Format. Three values are defined at this time. 'B' - IMODE = B 'P' - IMODE = P 'S' - IMODE = S
12	1-9999	H	2	Number of image blocks per row.
14	1-9999	V	2	Number of image blocks per column.
16	0-1	Image Color	1	Original image color representation. Two values are defined at this time. 0 - monochrome 1 - RGB
17	1-16	Image Bits	1	Original image sample precision.
18	0-99	Image Class	1	Image data class (0-99). One value is defined at this time 0 - general purpose
19	1 - 29	JPEG Process	1	JPEG coding process. The values of this field are defined to be consistent with ISO IS 10918-2. 14 - Sequential lossless
20-26	0x00		7	NULL padding bytes

C.5.1.9.2 NITF0003.A APP_7 directory data segment

NITF applications may use an NITF0003.A APP_7 directory segment. This APP_7 application data segment may be identified by the null-terminated (0x00) string "NITF0003.A" immediately following the length parameter L_p (see Table C.5.42). The directory segments are used to provide random access to the variable

length compressed data segments. These segments contain a directory of offset information for a series of scans or restart intervals depending on the directory type. In all cases, offsets are measured from the beginning of the Image Data Field in the NITF file to the beginning of the element. The number of entries depends on the directory type and is the number of (restart intervals per scan) or (scans per block) for directory types: 'R' and 'S', respectively. The format is shown in Table C.5.42. The number of directory entries can be very large for restart interval directories. In these cases it is possible for a directory to exceed the, ≈ 64 kbyte, segment limitation imposed by the 2 byte L_p field offset in any JPEG application data segment. Since each element requires 4 bytes in the directory, this translates to a maximum of 16,379 entries.

When a logical directory contains more than 16,379 elements, they must be split between more than one directory. In this case, multiple directory segments must follow each other with no other intervening data and they must be of the same directory type (restart interval). Each additional directory contains those elements, in the same order, that would have been present in the directory had there been no size limitation. Another mechanism called, blocked image masking, may be used in the NITF data format to provide direct access to image blocks, in the same spirit that directory segments provide access to entropy coded data. Blocked image masking requires the use of an image data mask subheader in the NITF file. The content, structure and use of block image masking may be found in MIL-STD-2500A.

Table C.5.42 - NITF APP_7 directory segments

Offset	Field Value	Field Name	length (bytes)	comments
0	0xFFE7	APP_7	2	NITF directory segment marker.
2	4N + 16	L_p	2	Segment length (2 + length of application data).
4	0x4E495446 0x30303033 0x2E4100	Identifier	11	Null-terminated string “NITF0003.A”.
15	0x52, 0x53	Directory Type	1	Directory type. Two values are defined at this time. ‘R’ - Restart Interval Directory ‘S’ - Scan Directory
16	1-16379	N	2	Number of directory entries. Note 0 is not allowed. Maximum value of N (16,379) maximizes L_p at 65532.
18		1st Offset	4	Offset to first element in this directory (restart interval, scan).
22		2nd Offset	4	Offset to second element in this directory.
4N + 14		Last Offset	4	Offset to last element in this directory.

C.5.1.10 Control procedures

The control procedures for encoding and decoding an image using this profile may be found in ISO/IEC 10918-1. It is required by this profile that an NITF APP_6 application data segment be placed in the compressed data stream. This data segment immediately follows the first SOI marker in the Image Data Field (see Figure C.5.1). The format and content of this data segment are discussed in section C.5.1.9.1. This profile also requires the use of restart intervals for the purposes of error confinement and data resynchronization. Restart intervals are discussed in C.5.1.11.2.4. NITF compressed imagery may include an optional APP_7 directory segment in the JPEG data stream, the format and content of this marker segment is discussed in C.5.1.9.2.

Figure C.5.1. NITF file structure

C.5.1.11 File Format

C.5.1.11.1 Format of a JPEG compressed image within an NITF file

The format for NITF image data compressed with the sequential lossless JPEG mode differs based on the number of blocks, bands, and IMODE value (B, P, S, see MIL-STD-2500A). These different cases are described below.

1.11.2 Single block JPEG compressed format

The format for NITF single block image data compressed with the sequential lossless JPEG mode is shown in Figure C.5.2**.**

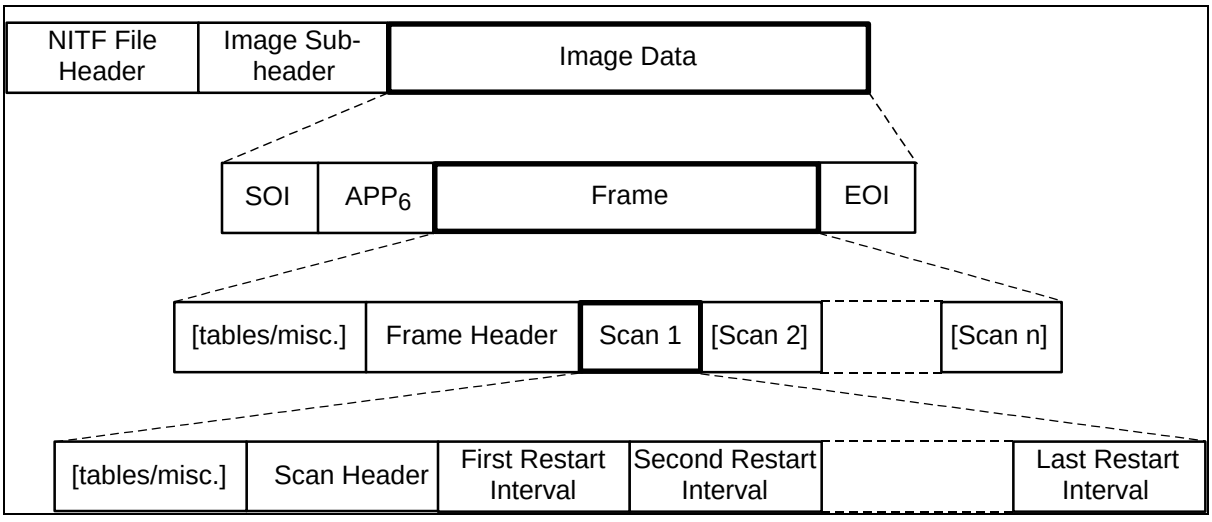

Figure C.5.2. NITF single block file structure (IMODE = B or P)

C.5.1.11.2.1 Single block image data format

The top level of Figure C.5.2 specifies that the JPEG compressed data is contained in the Image Data Field of the NITF file. The second level of Figure C.5.2 specifies that the single block image format shall begin with an SOI marker, shall contain one frame, and shall end with an EOI marker. Between the SOI/EOI marker pair, the data stream is compliant with ISO/IEC 10918-1 subject to the requirements and constraints of this profile.

C.5.1.11.2.2 Frame format

The third level of Figure C.5.2 specifies that a frame shall begin with a frame header and shall contain one or more scans. A frame header may be preceded by one or more table-specification or miscellaneous marker segments. NITF does not allow the use of the JPEG DNL segment which, when present, would follow the first scan in the frame.

C.5.1.11.2.3 Scan format

The fourth level of Figure C.5.2 specifies that a scan shall begin with a scan header and shall contain one or more restart intervals. A scan header may be preceded by one or more table-specification or miscellaneous marker segments. When the NITF image sub-header IMODE field is set to B, there shall be n scans within the frame, one for each of the components (n = 1 or 3). When the IMODE field is set to P, there shall be a single scan within the frame consisting of three interleaved components.

C.5.1.11.2.4 Restart intervals

Following the scan header, each scan shall be encoded as a series of one or more restart intervals. A restart interval is a self-contained entropy-coded data segment that can be decoded independently from the other intervals. Restart intervals are used for error recovery. If the image were encoded as a single interval, then any transmission error would render all subsequent image data unusable. When several restart intervals are used, the effects of an error can be contained within a single interval. The restart interval is defined by the DRI marker as specified in ISO/IEC 10918-1. In the ISO/IEC restart intervals are optional, but NITF requires the use of restart marker codes with a restart interval which is a multiple of the number of MCUs per row and not exceeding a maximum of 8 sample rows. Byte alignment is achieved between restart intervals per ISO/IEC 10918-1.

C.5.1.11.3 Multiple block JPEG compressed format

The format for NITF multiple block image data compressed with the sequential lossless JPEG mode is shown in Figure 3 for IMODE = B or P. The corresponding format when IMODE = S is shown in Figure 4**.**

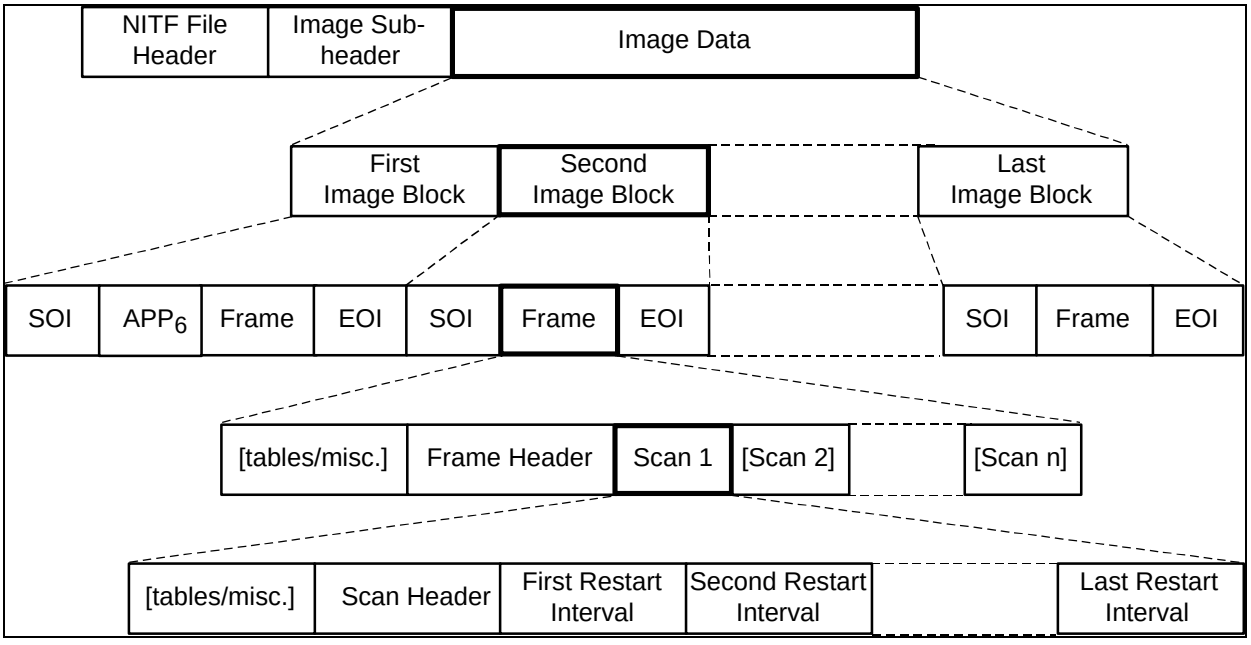

Figure C.5.3. NITF multiple block file structure (IMODE = B or P)

C.5.1.11.3.1 Multiple block image data format (IMODE = B or P)

The top level of Figure C.5.3 specifies that the JPEG compressed data is contained in the Image Data Field of the NITF file. The second level of Figure C.5.3 specifies that this multiple block image format shall begin with the compressed data for the first image block and shall be followed by the compressed data for each image block, one after the other, left to right, top to bottom. The third level of Figure C.5.3 specifies that each compressed block shall begin with an SOI marker, shall contain one frame, and shall end with an EOI marker. The format below this level is identical to the single block case previously described in C.5.1.11.2.

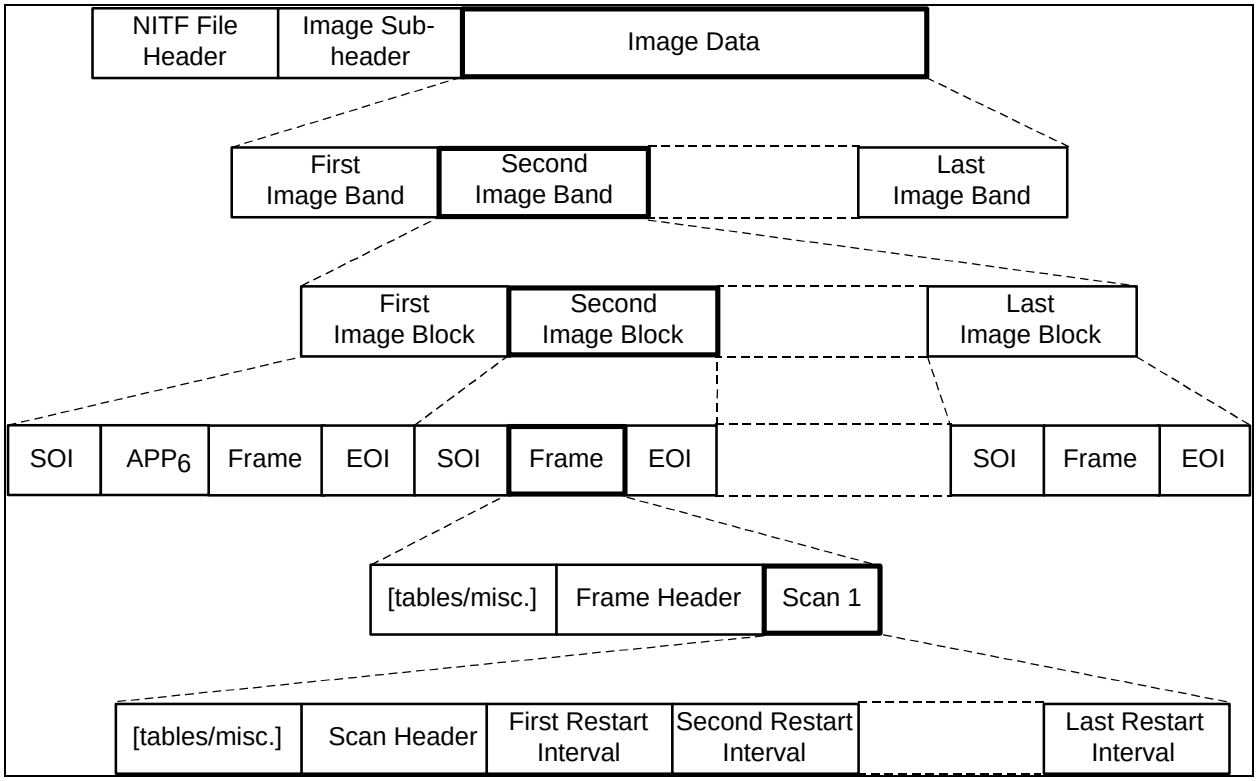

Figure C.5.4. NITF multiple block file structure (IMODE = S)

C.5.1.11.3.2 Multiple block image data format (IMODE = S)

The use of this IMODE requires that the image contain multiple blocks and multiple bands, otherwise IMODE shall be set to B or P. The top level of Figure C.5.4 specifies that the JPEG compressed data is contained in the Image Data Field of the NITF file. The second level of Figure C.5.4 specifies that this multiple block image format shall begin with the compressed data for the first image band and shall be followed by the compressed data for each image band, one after the other, first to last. The third level of Figure 4 specifies that each compressed image band shall consist of the compressed data (for that band) for each image block, one after the other, left to right, top to bottom. The fourth level of Figure C.5.4 specifies that each compressed block shall begin with an SOI marker, shall contain one frame, and shall end with an EOI marker. The format below this level is identical to the single block case previously described in C.5.1.11.2 with each frame containing only one scan that contains the compressed data from only one band.

C.5.1.11.3.3 Similarities with ISO/IEC 10918-3 “simple tiling”

In ISO/IEC 10918-3, extensions to the JPEG processes of ISO/IEC 10918-1 are defined. One of these extensions deals with the tiling (blocked images in NITFS terminology) of images. Of the tiling formats present in ISO/IEC 10918-3, simple tiling, is conceptually equivalent to the blocked image concept in NITF. It is important to note that the bitstreams generated by simple tiling in ISO/IEC 10918-3 and blocked images in NITF are not compatible. In ISO/IEC 10918-3 simple tiled images are treated as multiple frames within a single SOI/EOI marker pair. Image blocks in NITF are treated as separate images, each within their own SOI/EOI marker pair. Within the SOI/EOI marker pairs each image block data stream conforms to ISO/IEC 10918-1 subject to the requirements and constraints of this profile.

C.5.2. Informative Description

C.5.2.1 Applicability

This profile is applicable to the Intelligence Community and the Department of Defense. It is mandatory for all Secondary Imagery Dissemination Systems in accordance with the memorandum by the Assistant Secretary of Defense for C^3I, Subject: National Imagery Transmission Format Standard (NITFS), 12 August 1991. This directive shall be implemented in accordance with the Joint Interoperability and Engineering Organization (JIEO) Circular 9008, NITFS Certification Test and Evaluation Program Plan, and the MIL-HDBK-1300A. New equipment and systems, those undergoing major modification, or those capable of rehabilitation shall conform to this profile.

C.5.2.2Critical data

The JPEG marker segments (frame header, scan header, DHT, DRI, APP_6) are critical data. Corruption will result if these data are lost.

C.5.2.3Use of restart intervals

Restart intervals introduce some overhead into the data stream to provide a level of error protection. A "smart decoder" will detect a transmission error as an invalid data stream during the decoding process and then skip forward looking for the next restart marker code to resynchronize. There is a tradeoff between the amount of overhead and the level of protection obtained. Neglecting the effects of packet size and error handling in the communications protocol, errors can be contained to a single restart interval. The overhead introduced by each restart interval is 20 bits on average for Huffman coding.

ANNEX D - USIGS Profile of ISO/IEC 8632-1, CGM

Ann ISP for the NITFS implementation of ISO/IEC 8632-1, CGM, is currently in development. As details are available, it shall be included into this annex. When the ISO approves and registers the profile (TBR10), it shall become the authorotative document for development and procurement purposes, and shall supercede the contents of this Annex.

ANNEX E - USIGS Profile for Bi-level compression

Refer to Document CCITT Recommendation T.4- *Standardization of Group 3 Facsimile Apparatus for Document Transmission*, (Geneva, 1980, amended at Malaga-Torremolinos, 1984 and Melbourne, 1988) for implementation of the Bi-level compression standard previously defined in MIL-STD-188-196, Bi-Level Image Compression for the National Imagery Transmission Format Standard